Healthcare for People Who Inject Drugs:

Assessing Engagement and Unmet Need

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Abstract

Background: People who inject drugs (PWID) are an aging population with complex health needs. Multimorbidity is common and under addressed. Studies with PWID have shown that increases in the number of multimorbidity that were undiagnosed or undertreated, suggesting that care needs of this group are complex and impact healthcare utilization. Compounding this, PWID utilize healthcare at low rates, and care engagement is understudied. Lack of engagement in healthcare increases cost and worsens outcomes. However, no study to date has examined the impact of multimorbid chronic diseases on healthcare engagement for PWID and the holistic care needs of this population. Through an explanatory sequential mixed-methods study this research was designed to explore the healthcare needs of current and former PWID and how they engage in healthcare.

Methods: Guided by the Behavioral Model for Vulnerable Populations (BMVP), this dissertation includes a systematic review of literature followed by an explanatory-sequential mixed methods study. The quantitative aim was a secondary analysis from the AIDS Linked Intravenous Experience (ALIVE) cohort, followed by qualitative interviews with ALIVE participants. Latent class analysis (LCA) was used to identify classes of multimorbid chronic diseases and explore the degree to which individual characteristics and level of substance use was associated with class membership. Data from LCA informed purposive recruitment for qualitative interviews from each class. Qualitative descriptive method was applied for thematic analysis using the Behavioral Model for Vulnerable Populations as a conceptual framework.

Results: Dissertation findings include identification of complex healthcare needs for this population, the role of those needs on healthcare engagement, and can be applied to directions for future research, interventions, and policies. Healthcare need was characterized as three

distinct classes of multimorbidity found with latent class analysis, each with its own implications for healthcare utilization and engagement. Findings from quantitative and qualitative analysis showed health insurance status did not serve as a barrier to healthcare access, with almost ubiquitous coverage in this post-ACA era study. While continuity of care was not associated with any class of multimorbidity, participant interviews highlighted that patient-provider relationship, strengthened by integrated care, were important for healthcare engagement. Additionally, a subset of participants described the benefits obtained from focused case management for wrap-around services, particularly those with co-occurring mental health disorder. Thematic analysis from this class also highlighted the importance of mental health stability as a means for management of substance use or recovery and other chronic diseases. Finally, quantitative and qualitative analysis showed prescription of MOUD linked with certain multimorbid classes, highlighting this as an important contributor to healthcare engagement.

Conclusions: Multiple avenues for healthcare engagement, including positive patient-provider relationship, sustained health insurance, alignment of their healthcare needs with those designated by healthcare providers, and receiving integrated care to address pressing health needs among PWID. Policy considerations include the continued provision of low barrier access to publicly available insurance, passage of legislation that provides funding for clinics to provide wrap-around services to individuals with substance use disorder, and removal of MOUD prescription barriers impacting this at-risk population. Finally, this study affirms the importance of healthcare meeting the needs of this population at the level they are able to accept care. Holistic healthcare systems can address these needs best with integrated care systems that include harm reduction, are co-located with substance use and mental health treatment, and wrap around services, particularly as this population continues to age.

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PREFACE

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I started my graduate school journey five years ago with a move from California to Baltimore for the MSN-NP/MPH program at Johns Hopkins University. This dissertation is the culmination of five years of graduate studies, during which I became a practicing nurse practitioner, pushed the limits of my writing and scholarship, realigned my values, and recommitted myself to the service of vulnerable populations both as a clinician and now, as a scientist.

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CHAPTER 1: Introduction

People who inject drugs (PWID) are an aging population, with complex health needs. Treatment guidelines and healthcare services designed to provide care to adults who inject drugs often limit the scope of their guidelines to infectious disease treatment and prevention, soft tissue infections, and harm reduction, with little attention paid to engagement in healthcare for treatment of chronic diseases (Centers for Disease Control and Prevention, 2012; Low et al., 2016; Visconti, Sell, & Greenblatt, 2019). However for PWID, multimorbidity, defined as presence of two or more co-occurring diseases, is common and under addressed (Johnston, Crilly, Black, Prescott, & Mercer, 2019). This definition of multimorbidity developed with a patient centered lens whereby the quality of the diagnosed multimorbid diseases affect physical functioning and overall quality of life (Boyd, Cynthia M., Fortin, 2010; Giovannetti et al., 2013).

A random sample of patients attending a methadone dispensing primary care clinic found that 91% of individuals had at least one chronic illness (mean of 2.6); 68% of individuals receiving methadone were prescribed at least one additional medication for management of their chronic illness (Cullen, O'Brien, O'Carroll, O'Kelly, & Bury, 2009). Individuals receiving methadone had 4.4 times higher odds of having a documented chronic illness (Cullen et al., 2009). Data from a community cohort of current and former PWID in Baltimore, the AIDS Linked Intravenous Experience (ALIVE) study, found high prevalence of diabetes (8%), obstructive lung disease (19%), liver disease (22%), kidney dysfunction (27%), and hypertension (38%) (Salter, Lau, Go, Mehta, & Kirk, 2011). Increases in the number of multimorbid diseases in this study population were largely undiagnosed or undertreated, suggesting that care needs of this group are complex and impact healthcare utilization (Piggott et al., 2013, 2016; Salter et al.,

2011). Additionally, no study to date has examined the implications of multimorbidity for healthcare engagement for PWID.

Gruman and colleagues (2010) define engagement in healthcare as, "actions individuals must take to obtain the greatest benefit from the healthcare available to them." Increased healthcare engagement leads to improved health outcomes for substance use disorder and reduced cost to health systems (Chi, Parthasarathy, Mertens, & Weisner, 2011; Park, Cheng, Samet, Winter, & Saitz, 2015; Sujaya Parthasarathy, Chi, Mertens, & Weisner, 2012). However, PWID utilize healthcare at low rates compared to those who did not injection drugs and are often seen in later stages of disease (Artenie et al., 2015; Larney et al., 2017; Mizuno et al., 2015; Okeke, Ostermann, & Thielman, 2015; Oramasionwu, Moore, & Toliver, 2014; Osilla et al., 2011; Strathdee, Shoptaw, Dyer, Quan, & Aramrattana, 2012; Thompson, Mugavero, Amico, & Cargill, 2018; Westergaard, Hess, Astemborski, Mehta, & Kirk, 2013). Limited access and barriers that exist within the healthcare infrastructure drive this lack of engagement. Insurance status, sex, lack of health insurance, poor provider continuity, active substance use, and stigma are predictors of poor utilization and healthcare engagement (Hartzler et al., 2018; Westergaard et al., 2013; Westergaard, Kirk, Richesson, Galai, & Mehta, 2011). Still, several factors improve healthcare access and engagement. Medication for opioid use disorder (MOUD), integrated care services, and focused retention interventions have a positive association with engagement in care (Islam et al., 2013; Jack, Willott, Manners, Varnam, & Thomson, 2009; Mehta et al., 2015; Miller et al., 2018; Morozova, Dvoriak, Pykalo, & Altice, 2017; Parmenter et al., 2013; Wang et al., 2013). Lack of engagement in healthcare increases cost and worsens outcomes. Multiple studies have shown the cost effectiveness of managing substance use disorder in the primary care setting with implications of improved physical and mental health outcomes, as well as decreased

substance use (Babor, Mcree, Kassebaum, Grimaldi, & Ahmed, 2007; Krupski et al., 2016; Parthasarathy, Mertens, Moore, & Weisner, 2003; Parthasarathy, Weisner, Hu, & Moore, 2001). However, no study to date has examined the impact of multimorbid chronic diseases on healthcare engagement for PWID and the holistic care needs of this population.

Conceptual Framework

This project will utilize the Behavioral Model for Vulnerable Populations (BMVP), an adapted framework from the Andersen Healthcare Utilization Model. The first iteration utilized three domains associated with an individuals' likeliness to utilize health care services: Predisposing, Enabling, and Need (Andersen, 1968). Later updates to the model included Health Behaviors that also influence health care utilization (Andersen, Davidson, & Baumeister, 2013). Finally, this model was adapted to include domains specific to its use with vulnerable populations (Gelberg, Andersen, & Leake, 2000).

Predisposing characteristics primarily include demographic data of age, sex, race, and education. Enabling variables include income, employment status, and insurance coverage. From Need, the presence or absence of the diseases, will be the source of multimorbid disease classes from latent class analysis (Table 3). Finally, Health Behaviors are patterns of substance use. Figure 1 displays how this project will utilize elements of the Predisposing, Enabling, Need and Health Behavior domains for to guide data collection and analysis of the proposed aims.

Purpose and Specific Aims

This study was designed then with the following overarching research question:

What are the healthcare needs of people who inject drugs and how do they engage in healthcare?

Through an explanatory sequential mixed-methods study this research will explore the healthcare needs of current and former PWID and how they engage in healthcare. The specific aims of this study were to:

Aim 1: Assess current evidence to identify the barriers and facilitators to healthcare engagement for the population of PWID with continued active injecting.

Aim 2: Characterize the classes and predictors of multimorbid non-communicable and communicable chronic diseases among PWID using latent class analysis. We will then examine the relationship between classes of multi-morbid chronic diseases with individual characteristics and patterns of substance use.

Aim 3: Understand the barriers, facilitators, challenges faced, and resources utilized for healthcare engagement among ALIVE participants from each multimorbid latent class.

This dissertation includes a systematic review of literature, a secondary analysis of data from the ALIVE cohort (PI: Shruti Mehta), and in-depth qualitative interviews with ALIVE participants. Latent class analysis (LCA) will facilitate the identification of multimorbid chronic disease classes and testing the degree to which individual characteristics and level of substance use predicts class membership. Data from the latent class analysis and the Behavioral Model for Vulnerable populations will inform the field guide for the qualitative interviews. Participants from each latent class identified in aim 2 will be the recruited for participation in aim 3.

The proposed research examines engagement in healthcare for substance use treatment and underlying multimorbid chronic diseases and will lay the foundation for a career as a clinician-scientist dedicated to mitigating the harms of substance use within the primary care setting. The proposed aims are closely aligned with NIDA's Services Research Branch priorities

as its findings have direct implications for improving healthcare for multimorbid chronic diseases, substance use treatment, continuity of care, and informing integration models for PWID. Findings from this study will inform interventions and integrated care systems that reduce drug use, provide a pathway to cessation or avenues for harm reduction, and address chronic disease diagnosis and long-term management.

Methodology: Parent Study

The parent study, the AIDS Linked Intravenous Experience (ALIVE) cohort, is the longest running prospective cohort with current and former PWID and funded by NIDA. Its three aims are: (1) monitor temporal trends in the opioid epidemic comparing HIV infected and uninfected PWID across the lifespan, including characterization of shifting drug profiles and context over time and their impact on the incidence of fatal and non-fatal overdose; (2) to evaluate the dynamic associations between HIV care outcomes and prevalence and control of NCDs (e.g., diabetes, hypertension, chronic obstructive pulmonary disease) and impact on morbidity, mortality and quality of life (QOL); and (3) to provide a platform for independently-funded investigations of HIV and drug use. The parent study enrolled a representative sample of current and former injection drug users. Study participants commonly refer potential participants. Inclusion criteria into ALIVE are: 1) age >=18 years and 2) reporting injection drug use in the last year. The only exclusion is not being able to provide informed consent. Table 1 shows demographics of individuals currently under follow-up.

Organization of the Dissertation

There are 5 chapters in this dissertation; chapters 2-4 are formatted as manuscripts for publication. Chapter 1 introduces the dissertation and provides background information relevant to the study purpose, conceptual framework, and aims of the dissertation.

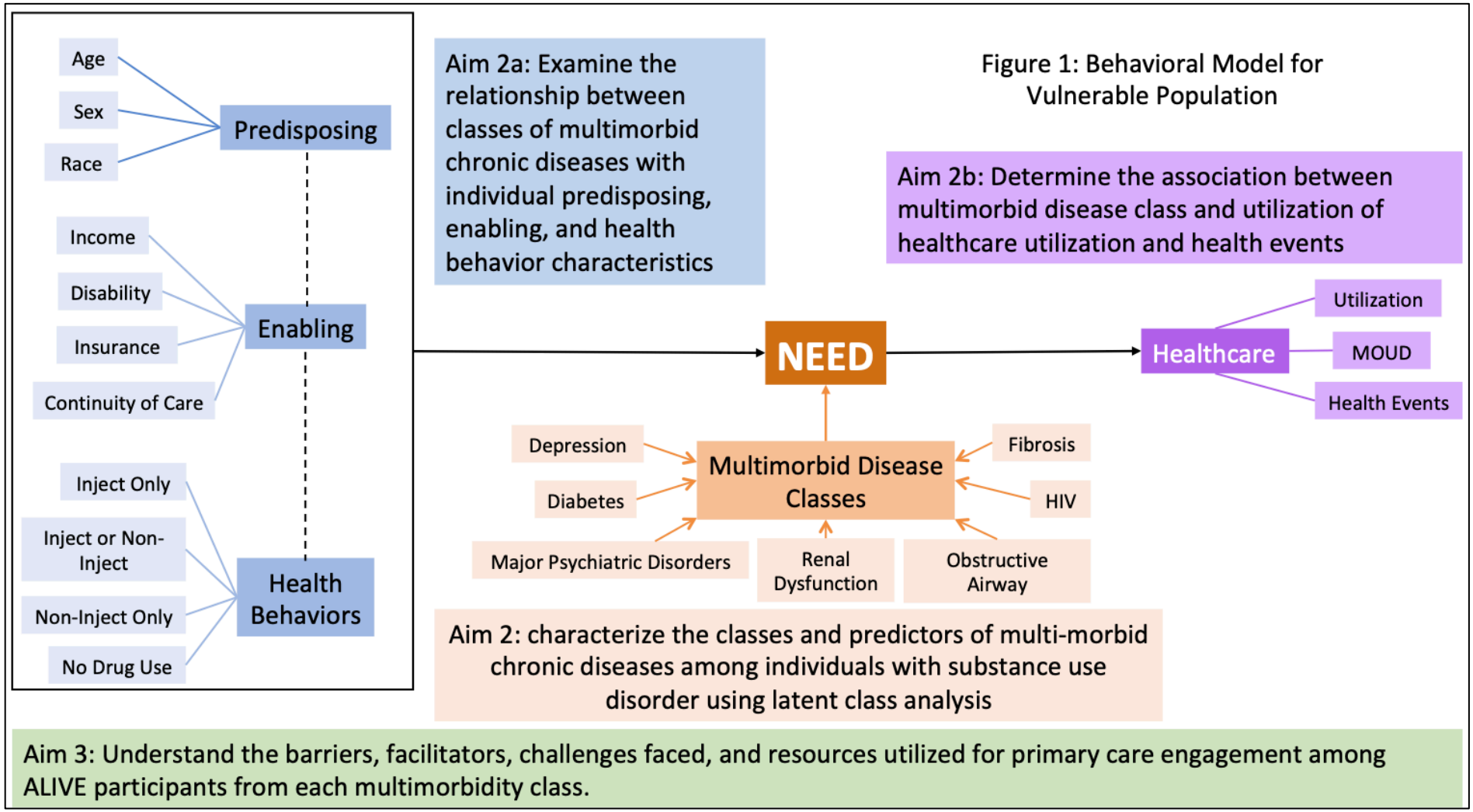
Chapter 2 is a systematic review of literature with the purpose assessing current evidence to identify the barriers and facilitators to healthcare engagement for the population of PWID with continued active injecting. Findings highlight key areas for care engagement for this population but also the difficulty of quantifying outcomes of engagement in care. Future studies should consider an adapted framework of the Behavioral Model and multiple outcomes to quantify engagement in healthcare.

Chapter 3 presents the findings from Aim 2. Using data from 604 ALIVE participants, latent class analysis identified three classes of multimorbidity: *Low Multimorbidity, Multimorbidity,* and *Multimorbidity with Psychiatric Comorbidity.* In regression analysis using *Low Multimorbidity* as the reference group, individuals in the *Multimorbidity* class were more likely to receive disability and were less likely to inject drugs. Individuals in the *Multimorbidity with Psychiatric Comorbidity* class were more likely to be female, receive disability, and have low income. Compared to the *Low Multimorbidity* class, individuals in the *Multimorbidity* and *Multimorbidity with Psychiatric Comorbidity* were more likely to utilize outpatient healthcare services, with the later group also more likely to utilize emergency room services.

Chapter 4 presents the findings from Aim 3. A total of 24 interviews were conducted with individuals from each multimorbid class. Thematic analysis was conducted using the domains of the BMVP. *A priori* and *in vivio* themes in each of the domains demonstrated areas of engagement in care that can inform clinical practice, policy, and future research for engaging PWID in care specifically and for each multimorbid latent class specifically.

Chapter 5 synthesizes the findings of the dissertation. Lessons learned from the study are discussed, along with implications of the results, situated within the study's strengths and limitations, for better engaging PWID in healthcare.

Figure 1.1 Behavioral Model for Vulnerable Populations



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CHAPTER 2: Factors associated with healthcare engagement for people who inject drugs with continued substance use.

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Abstract

People who inject drugs (PWID) have similar or even increased burden of multi-morbid chronic diseases compared to the general population. However, little attention has been paid to the engagement of this population in primary care for services related specifically to their injection drug use as well as management of their underlying chronic co-morbid diseases. This systematic review, utilizing the Behavioral Model for Vulnerable Populations (adapted from the Andersen Model for Healthcare Utilization), reviewed evidence related to the engagement of this population in the primary care setting and identified facilitators and barriers associated with care engagement. Twenty-eight articles were selected using the Preferred Reporting Items for Systematic Reviews and meta-Analyses (PRISMA) checklist. Factors of co-location of services, case management, active injection, and patient-provider relationship were associated with health utilization and engagement. The factors identified can be utilized by future intervention and studies to better integrate the care needs of this population holistically in one setting with the goal of reducing the morbidity and mortality associated with injection drug use.

Introduction

As a group, individuals who engaged in substance use have a high number of co-occurring medical conditions. In a retrospective review of over 800 patients with active substance use, Krupski et al (2015) found hypertension (47%), tobacco use (46%), depression (43%), hyperlipidemia (24%), HCV (22%), and diabetes mellitus (21%) were among the most frequently recorded ICD-9 codes. In a random sample of methadone and non-methadone using patients, 91% had at least one listed chronic illness with a mean of 2.6 chronic illnesses documented; 68% of individuals receiving methadone were prescribed at least one additional medication for the management of their chronic illness (Cullen, O'Brien, O'Carroll, O'Kelly, & Bury, 2009). Individuals receiving methadone were at 4.4 times higher odds of having a documented chronic illness compared to the non-methadone receiving controls (Cullen et al., 2009). Further, despite being engaged in care, one longitudinal cohort among people who inject drugs (PWID) identifies that individuals with a detectable HIV viral load were also more likely to have uncontrolled comorbid diseases like diabetes or hypertension (Monroe, Chander, & Moore, 2011). Multimorbid diseases in this population were largely undiagnosed or undertreated (Salter, Lau, Go, Mehta, & Kirk, 2011).

Government organizations and national interest groups concerned with the health and well being of this population often limit the scope of their guidelines to harm reduction with little attention paid to engagement in primary care. Guidance from the Centers for Disease Control and Prevention (CDC) for primary and preventative care with PWID often centers on the prevention of infectious diseases, namely Human Immunodeficiency Virus (HIV), Hepatitis C (HCV), Hepatitis B (HBV), Sexually Transmitted Infections (STIs), and Tuberculosis (TB) but mention the importance of referral and engagement in primary care for integrated services.

(Centers for Disease Control and Prevention [CDC], 2012). Their latest guidelines that mention engagement of PWID in primary care focuses on delivery of needle exchange programs embedded within these sites (CDC, 2015). The Substance Abuse and Mental Health Services Administration (SAMHSA) has offered funding to health care organization that integrate mental health and primary care but will little attention paid to the at risk group of PWID (Center for Mental Health Services, 2015). With the passage of the Comprehensive Addiction and Recovery Act (CARA) by Congress in 2016 allowing Nurse Practitioners and Physicians Assistants to prescribe medications for opioid use disorder and manage care for PWID, there is increased attention to the role primary care can play in managing the holistic care of this population. The health care needs of this population clearly lie beyond opioid replacement therapy and sequela related to harmful injection practice (deep disuse infection/injury, overdose, etc.) (Nambiar et al., 2014). Strategies for improving chronic illness identification for PWID as well as for primary care interventions that facilitate primary care engagement, adherence and improved outcomes are sorely needed.

The Behavioral Model for Vulnerable populations, adapted from the Andersen Model for Healthcare Utilization, examines Predisposing, Enabling, Need, and Health Behavior characteristics associated with healthcare utilization and engagement (Andersen, 1968; Andersen, Davidson, & Baumeister, 2013; Gelberg, Andersen, & Leake, 2000). Predisposing factors are individual characteristics and include age, gender, and relationship status, sexual orientation, and substance use. Enabling characteristics are organizational and financing factors and include health insurance status, health service resources, and region of residence. Need characteristics refer to those that are both perceived by an individual and those evaluated by

healthcare providers. Finally, Health Behaviors are those actions taken by PWID that inhibit or enable their ability to engage in their healthcare.

Previous systematic reviews have examined engagement in primary care, one of which utilized the Andersen Health Care Utilization model as its theoretical framework (Brennan, Morley, O'Leary, Bergin, & Horgan, 2014), yet the review's inclusion criterion was literature with study populations of people living with HIV and determinants related to hospital based outpatient care utilization. Islam, et al (2012) conducted a systematic review focused on PWID and outpatient care related to models of care delivery and accessibility and acceptability (Islam, Topp, Day, Dawson, & Conigrave, 2012).The purpose of this review was to assess current evidence to identify the barriers and facilitators to primary care engagement for the population of PWID with continued active injecting.

Methods

This review utilized the Preferred Reporting Items for Systematic Reviews and meta-Analyses (PRISMA) checklist for its organization and reported elements (Moher, 2009). Searches were conducted in PubMed, CINAHL, and EMBASE using the following combination of MeSH (or CINAHL/EMBASE equivalent) and search terms in three topic areas:

1) Engagement in Care: Patient Participation [Mesh], Patient Acceptance of Health Care [Mesh], Patient Compliance [Mesh], engag* [tw], participat* [tw], accept* [tw] or involv* [tw]
2) Intravenous Substance Use: Substance Abuse, Intravenous [Mesh], "iv drug use" [tw], "iv drug abuse" [tw], "intravenous drug use" [tw], "intravenous drug abuse" [tw], "intravenous drug abuser" [tw], "intravenous drug abusers" [tw], "people who inject drugs" [tw], "injection drug user" [tw], or "injection drug users" [tw]
3) Primary healthcare: "Primary Health Care"[Mesh], "Primary Care Nursing"[Mesh], "Physicians, Primary Care"[Mesh], "Nurse Practitioners"[Mesh], "Preventive Health Services"[Mesh:NoExp], "Primary Prevention"[Mesh], "Secondary Prevention"[Mesh], "Tertiary Prevention"[Mesh], "primary health" [tw], "primary care" [tw], "primary prevention" [tw], "secondary prevention" [tw], or "tertiary prevention")

Reference lists from studies that met inclusion criteria were also reviewed for additional studies that did not turn up in the above search. Quantitative and qualitative studies were considered for inclusion.

Figure 1 displays the PRISMA consort diagram. A total of 770 articles were found using the search terms in PubMed, CINAHL, and EMBASE, 60 of which were duplicates. OH and KT screened 710 title and abstracts for relevance. An additional five were included from reference lists of articles reviewed in the full text phase. OH and KT reviewed 126 full texts for inclusion, with JF breaking a tie in one case of disagreement.

Articles that reported a study population made up of PWID and outcomes related to engagement in primary care including diagnosis of disease, linkage or retention in care, disease related outcomes, or reported patient-provider care preferences, were included in the study. Articles with study populations only partially made up of PWID were considered for inclusion if they stratified analysis to include effect estimates for PWID. Studies were excluded if they did not explicitly measure engagement outcomes with PWID or did not report any domains related to engagement in primary care. Additionally, given differences in healthcare delivery and systems, study populations outside the United States were excluded. Finally, only data limited to active injection (reported injection in the last year) were included in this study; studies reporting a history of IDU, or IDU as the transmission factor in the case of HIV and HCV articles, were not included.

The Behavior Model of Healthcare Utilization was used to extract data from selected articles. Studies were categorized into factors associated with the predisposing, enabling, need, or health behavior domains; studies could straddle these domains based on the factors studied. The following definitions were utilized for the three domains of the model: Predisposing

characteristics are those existing conditions that are not directly responsible for an individual's decision to engage in care (ex. age, sex, race); Enabling conditions are facilitators or barriers to care engagement (ex. stigma, structural barriers, delivery of salient services, etc.) outside the individual's control; Need conditions are divided into actual need (presence of a medical condition) and perceived need (the level to which providers recommend and patients desire care engagement; Health behaviors included substance use patters and harm reduction uptake as it related to engagement and utilization of healthcare (Andersen, 1968; Andersen et al., 2013; Gelberg et al., 2000). Data extraction and quality assessments were based on published guidelines (Center for Reviews and Dissemination [CRD], 2009; Wong, Cheung, & Hart, 2008).

Results

Study Characteristics

A total of twenty-eight articles were included in the final review. Figure 1 displays the number of articles excluded at each stage and the reasons for exclusion. Table 1 displays the study characteristics for each included articles. The majority of articles (68%) were rated as 'Good' quality, with nine articles rated as 'Fair' or 'Poor' (Table 2). The main issue affecting methodological quality was lack of information regarding data sources and low-level statistical analysis (CRD, 2009; Wong et al., 2008). Table 3 presents a summary of factors associated with healthcare engagement.

Predisposing

Sex

Two studies measured the impact of sex on engagement outcomes, both related to HIV care. When comparing prevalence ratios over time, one study saw increases in uptake in ART for both females (aPR 1.15; 95% CI 1.06, 1.24) and males (aPR 1.06; 1.01, 1.10), with females

having the higher prevalence ratio (Hoots, Finlayson, Broz, & Paz-Bailey, 2017). In contrast, the other study, which reported outcomes stratified by sex and race, found that White females had the lowest percentage of person-time in care after ART initiation and that both White and Black females had the greatest percentage of person-time in care with a viral load>1,500 copies/mL (Lesko, Lau, Chander, & Moore, 2018). The later study, however, only displayed percentages of person-time stratified by race and sex with ART and viral load outcomes without conducting relevant multivariate analysis or testing for differences between the groups.

Race and Ethnicity

Four studies measured race with engagement outcomes. Two studies demonstrated higher engagement for Black and Hispanic individuals with an increase in ART at each 3-year reporting period (Hoots et al., 2017) and that Hispanic and non-Hispanic Black individuals had greater odds of receiving an HIV prevention discussion from their healthcare provider at their most recently visit (J. Wilkinson et al., 2006). Additionally, one article with a nationally representative cohort of people living with HIV engaged in primary care found that Black PWID were significantly less likely to report recent injection drug use (aOR 0.26; 95% CI 0.16, 0.42) (Mimiaga et al., 2013). Finally, in contrast to these three, one article reported Black race associated with lower odds of utilizing drug treatment (aOR 0.41; 0.21, 0.78) (Riley, Wu, et al., 2002), though this study was conducted in the setting of a needle exchange.

Education

Results regarding education and engagement were mixed. Two studies demonstrated lower education associated with increased engagement outcomes (Hoots et al., 2017; J. Wilkinson et al., 2006) while two additional studies found that those with a self-report education less than 8th grade had significantly lower odds of engagement behaviors (Barocas et al., 2014;

Knowlton et al., 2010). However, while measured outcomes between all four studies differed, it is feasible that individuals with lower education had increased access to ART and care over time (Hoots et al., 2017; J. Wilkinson et al., 2006) but when compared to those with increased education in a cross-sectional analysis, were at lower odds of taking ART (Knowlton et al., 2010) and reporting HCV testing in the prior year (Barocas et al., 2014).

Age

Using a cutoff of age 50, age groups above and below both had increases in prevalence in ART uptake over time, while older age was associated with increased engagement (Hoots et al., 2017; Knowlton et al., 2010; Riley, Safaeian, et al., 2002). Young individuals were more likely to be injecting (Mimiaga et al., 2013) but also had greater adjusted odds of willingness to use pre-exposure prophylaxis given active injection (aOR 3.05; 95% CI 1.44-6.50) (Kuo et al., 2016).

Enabling characteristics

Health insurance

Across the five studies that examined the effect of health insurance on a measure of engagement in care, all showed a significant positive association. Multiple studies demonstrated an increase in primary care and drug treatment utilization, with point estimate odds raging from 2.00 to 2.58 (Barocas et al., 2014; Riley, Safaeian, et al., 2002; J. D. Wilkinson et al., 2007). Additionally, having health insurance was associated with increases in ART uptake (Hoots et al., 2017; Knowlton et al., 2010). Additionally, one qualitative study also indicated that the high cost of healthcare as a salient barrier.

Co-location of services

Three studies reported quality measurements related to co-location of primary care services with another service salient to PWID (i.e. HIV, Hepatitis C treatment, buprenorphine). Results were promising with high retention in care (61%) with buprenorphine services offered in primary care, high success for hepatitis C treatment (98%) when done with in an opioid treatment program, and high uptake of ART (84%), pneumocystis pneumonia prophylaxis (77%), and preventative care screenings for PWID living with HIV (Butner et al., 2017; Hersh, Little, & Gleghorn, 2011; O'Connor, Molde, Henry, Shockcor, & Schottenfeld, 1992). These studies, however, reported on care outcomes without exploring differences by individual or structural factors, or selecting comparison groups for a nuanced analysis.

Patient-provider relationship and stigma

The two articles that examined the effect of patient-provider relationship on engagement in care both indicated a positive relationship associated with increased engagement while a negative relationship adversely effected engagement (Barocas et al., 2014; Knowlton et al., 2010). Three qualitative articles (Biello et al., 2018; Oliva, Rienks, & McDermid, 1999; Skeer, Ladin, Wilkins, Landy, & Stopka, 2018) found that negative experiences with healthcare providers a barrier for later accessing care. Biello et al., contextualized the quantitative and qualitative findings, demonstrated by the following:

> "The minute [the doctors] find out you are a drug addict, that you are an injection [drug] user, you can see it right in their face. They change their whole attitude. They do not want to help you...I hate telling the doctor that I use drugs...because they are going to blame anything wrong with you on the drug use."

Case management

Two articles demonstrated the positive effect of case management and targeted linkage to care on healthcare engagement (Kidorf, King, Gandotra, Kolodner, & Brooner, 2012; J. D. Wilkinson et al., 2007). One in particular demonstrated that when combined with a financial

incentive, PWID undergoing multiple sessions for linkage to care and treatment readiness were more likely to enroll in a drug treatment program (aOR 2.52; 95% CI 1.23- 4.24) and spent more days in drug treatment compared those with a standard of care referral ($p<0.001$); though the authors note the difficulty in scaling this linkage to care intervention with an incentive, similar significant but attenuated odds were seen when comparing the linkage to care intervention alone to standard of care (Kidorf et al., 2012).

Housing

Both articles that examined the effect of housing found a deleterious effect of homelessness on engagement in care (Knowlton et al., 2010; Liappis, Laake, & Delman, 2014). Among those living with HIV, those actively engaged in injection drug use were more likely to report homelessness compared to those with non-active IDU ($p<0.001$); active PWID in that study were found to have worse health outcomes, even when utilizing HIV primary care (Liappis et al., 2014). Conversely, stable housing was significantly associated with uptake of ART (Knowlton et al., 2010).

Peer networks

Norms within peer group acted as barriers and facilitators to healthcare engagement. Two studies demonstrated the positive effect of peers on engagement, one where peers acted as a social support during drug treatment and medication adherence (Broadhead et al., 2002) and another where norms for safer drug use were associated with decreased odds of sharing injection equipment (aOR 0.92; 95% CI 0.86, 0.98) (Latkin et al., 2008). The former study, however, only piloted its peer support program with 14 patients and its findings are not generalizable without further study. Finally, one qualitative study found among PWID, HIV related stigma within social networks was a barrier to uptake of PrEP (Biello et al., 2018).

Need characteristics

Perceived need

Two studies found significant associations between an increased number of care visits and engagement in healthcare (Knowlton et al., 2010; Latkin et al., 2008) with one additional study noting that rating HIV care 'very important' (aOR 1.77; 1.31, 2.37) and engagement with a provider (aOR 1.72; 1.17, 2.57) as significantly associated with an HIV prevention discussion with a healthcare provider (Wilkinson et al., 2006). When perceptions of healthcare need and access were measured, two studies found negative associations with being an active injection drug user and difficulty accessing care (Biello et al., 2018; D D Chitwood, McBride, French, & Comerford, 1999), with the qualitative study noting a theme of competing healthcare needs and priorities related to active drug use and dependence (Biello et al., 2018).

Actual need

In two studies, disease stage was significantly associated with engagement in healthcare, where individuals with a CD4 counts <350 more likely to be taking ART at the 6 month follow up visit (aOR 1.65; 1.23, 2.22), while those with CD4 counts >= 200 associated with more visits with a primary care provider (aOR 1.64; 1.10, 2.46) (Knowlton et al., 2010; Wilkinson et al., 2007). Both were from the INSPIRE study and the same time period of analysis, though measurement of ART outcomes was defined as taking ART at least 1 day in the prior month (Knowlton et al., 2010). Five studies measured comorbidities among PWID. Two demonstrated PWID more likely to be diagnosed with common infectious and non-infectious chronic diseases (Liappis et al., 2014; Mimiaga et al., 2013), with one qualitative study found illness level as a major theme, which acted as a barrier to accessing Hepatitis C care (Skeer et al., 2018). The final two studies measured syndemic psychological and structural distress without diagnosis of a

mental health disorder, finding that higher levels of psychological distress was associated with increased sharing of drug paraphernalia and increased number of psychological and structural problems significantly associated with not taking ART, poor adherence to ART, and a detectable viral load (Latkin et al., 2008; Mizuno et al., 2015).

Health Behavior

Ongoing injection drug use

Ten studies noted the adverse effect of active injection drug use on engagement in healthcare (Brewer et al., 2007; Butner et al., 2017; Chitwood, Sanchez, Comerford, & McCoy, 2001; Chitwood, Comerford, & McCoy, 2002; Kavasery et al., 2009; Knowlton et al., 2010; Marquez, Mitchell, Hare, John, & Klausner, 2009; Mimiaga et al., 2013; Ompad et al., 2004; Westergaard, Hess, Astemborski, Mehta, & Kirk, 2013). While outcomes of engagement in care were measured differently, with respect to active injection, three found negative associations with ART uptake and adherence (Kavasery et al., 2009; Marquez et al., 2009; Mimiaga et al., 2013) and another three found decreased healthcare visits and satisfaction (Brewer et al., 2007; Chitwood et al., 2001; Chitwood et al., 2002).

Harm reduction

Two studies measured harm reduction and healthcare engagement. Exchanging more needles was associated with utilization of primary care (Riley, Wu, et al., 2002) while those who shared works were significantly more likely to report willingness to use PrEP (Kuo et al., 2016).

Discussion

This systematic review sought to determine factors related to engagement in primary care for people who inject drugs with active use. Data from articles chosen for review were abstracted into factors contained within predisposing, enabling, need, and health behavior domains of the

Behavioral Model for Vulnerable Populations (Gelberg et al., 2000). To our knowledge this is the only review of evidence that examined the factors related to primary care engagement for people who inject drugs with active injecting.

Two prior systematic reviews have been conducted in this population. Brennan, et al (2014) conducted a systematic review that utilized the Andersen Health Utilization Model among people living with HIV utilizing hospital based outpatient services. Another review reviewed literature between 2000-2010 and examined models of primary care delivery and acceptability of these services by PWID (Islam et al., 2012). Additionally, Visconti, Sell, and Greenblatt (2019), published an article related to primary care for people who inject drugs, but did not take a systematic approach and only reported clinical care recommendations.

Many important themes emerged from the synthesis of literature but to varying degrees of strength. From the Enabling domain, patient-provider relationship emerged as a strong factor related to care engagement where, across all the studies reviewed, positive patient-provider relationship was associated with greater engagement with negative relationships associated with less engagement. Co-location of services also emerged as a facilitator to primary care engagement, but studies associated with this finding were not highly rated due to their methodologically poor statistical analysis. Other studies with PWID have also demonstrated that medication of opioid use disorder (MOUD) in the primary care setting as a factor correlated to engagement in healthcare, though they did not meet criteria for inclusion in this review (Islam et al., 2013; Jack, Willott, Manners, Varnam, & Thomson, 2009; McNeil, Small, Wood, & Kerr, 2014; Mehta et al., 2015; Morozova, Dvoriak, Pykalo, & Altice, 2017; Parmenter et al., 2013; Wang et al., 2013). Case management and strong peer support appeared in multiple articles as a strong facilitator to engagement in care. Finally, current insurance status was a strong predictor

of healthcare engagement across the five studies that measured it, but only two were published on data collected after the Affordable Care Act, suggesting that linkage to healthcare insurance, rather than access, can be more salient to healthcare engagement with the expansion of health insurance.

Predisposing factors were not well measured or well represented across the studies with a few exceptions. Only one study stratified analysis by sex but did not providing proper effect estimates (Lesko et al., 2018). As a whole, measures and comparisons of race and ethnicity were also inconsistent. While differences in race as a predisposing factor were reported in the results section, little can be drawn from them without reported effect estimates. Anrdo- and ethnocentrism was evident since many studies had samples that were over 50% male and rarely had balance in racial and ethnic groups reported.

Evidence from the Need domain described the complicated nature of care engagement for PWID. Studies demonstrated high burden of multimorbidity, difficulty with accessible healthcare services that meet perceived needs, and the competing nature of active substance use with engagement in primary care. Health behaviors were most consistently measured across studies, with strong evidence for active injecting as a salient barrier to care engagement. This can be an area where clinical practice better assess injecting practices and provides harm reduction services in the primary care setting (Visconti et al., 2019).

There were multiple limitations to this study. Filters on publishing date were not applied to this systematic review. This introduces bias as secular changes in healthcare policy and service access contribute greatly to healthcare engagement. The majority, 61% of articles, included here, were published in the last decade, in the post-Affordable Care Act era. Strict inclusion criteria proved limiting as only studies conducted in the United States and with an

actively injecting population were included. While this inclusion yielded 28 studies for review, many additional studies with potentially relevant finding were excluded because they only reported a history of IDU or IDU as a transmission factor only, or were conducted outside the United States. Finally, engagement in healthcare as an outcome proved difficult for data synthesis, as outcomes for engagement are wider ranging than healthcare utilization measures alone. This wider definition, however, allows for more nuanced analysis and understanding of healthcare needs for this population. Future studies with PWID will benefit from collecting and reporting on active versus historical injection drug use and with a clear conceptual framework for healthcare engagement outcomes.

In conclusion, several factors were found to be barriers or facilitators to engagement in primary care for PWID. With the ongoing opioid epidemic, careful attention should be paid to how to engage individuals in the primary care setting for needs outside the traditional infectious disease and MOUD areas researched (Nambiar, Stoové, & Dietze, 2014). Clinical practice and research should continue to view patients and research participants' holistic needs rather than the sum of their disease parts. While most of the studies here fell under aforementioned areas for PWID, the findings and factors associated with the Behavioral Model for Vulnerable Populations from this study can direct future research.

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Table 2.1 Characteristics of included studies						
Reference	Participant Characteristics	Type of Study	Source of Data	Time period of data	Number of patients included	Duration of follow-up
(Barocas et al., 2014)	PWID utilizing a free syringe exchange program	Mixed methods with cross sectional quantitative design	88-item questionnaire and qualitative interview	June-August 2012	553 quantitative 362 qualitative	n/a
(Biello et al., 2018)	HIV uninfected PWID	Qualitative	Semi structured interviews	2017	33	n/a
(Broadhead et al., 2002)	PWID living with HIV	Intervention feasibility	Demographic and selected outcomes collected by health educator overseeing the study	1996	14	Up to 14 weeks
(Brewer et al., 2007)	PLWH recently positive with less than 1 visit to primary care and not initiated ART	ARTAS randomized clinical trial that sought to evaluate a case management intervention	Baseline ARTAS data	May 2001-May 2002	282, 31 PWID	n/a-
(Butner et al., 2017)	PWID enrolled in an OTP and receiving direct acting antiretroviral for HCV treatment	Retrospective program evaluation	Clinical charts	2015	74	Through SVR (12 weeks following completion of treatment)
(Chitwood, McBride, French, & Comerford, 1999)	Individuals with current IDU, non-IDU substance use, or nondrug users	Cross sectional	Multiple questionnaires collected by trained study staff	April-November 1996	536, 160 PWID	n/a
(Chitwood, Sanchez, Comerford, & McCoy, 2001)	Individuals with current IDU, non-IDU substance use, or nondrug users	Cross sectional	Multiple questionnaires collected by trained study staff	April 1996-November 1997	1,254, 224 PWID	n/a
(Chitwood, Comerford, & McCoy, 2002)	Individuals with IDU, non-IDU substance use, or non-drug users	Cross sectional	Multiple questionnaires collected by study staff	April 1996-Nov. 1997	1,477, 384 PWID	n/a
(Hayes et al., 2014)	Young PWID enrolled in the UFO study consenting to this sub-study	Cross sectional	Questionnaire administered by trained study staff and self-determined HCV test	2012-2013	127	n/a
(Hersh et al., 2011)	Individuals enrolled in the Office based opiate treatment program (OBOT) pilot program	Program evaluation	Secure database of data collect at clinical visits	September 2003-August 2005	57	Up to 12 months
(Hoots et al., 2017)	PWID participating in the National HIV Behavior Surveillance (NHBS)	3 cross-sectional data collections	NHBS	2009-2015	2009: 548 2012: 608 2015: 545	n/a

(Kavasery et al., 2009)	PLWH and reporting IDU in the last year at baseline	Longitudinal prospective cohort	AIDS Linked Intravenous Experience; biannual data collection	1996-2005	335	Up to 10 years
(Kidorf et al., 2012)	Opioid dependent PWID at a NEP	Randomized trial	Baseline intervention followed by monthly data collection visits by study staff	May 2003-March 2007	281	1 years following randomization
(Knowlton et al., 2010)	Eligibility criteria included injection drug use in the past year, willingness to participate in group education session, and sex with an opposite-sex partner in the last 3 months	Secondary HIV prevention intervention study	Data from baseline and 6 month follow up study visits	2001-2005	Full sample: 1,225 HIV Primary Care: 1,040	12 months for full study but 6 months in this analysis
(Kuo et al., 2016)	PWID participating in the National HIV Behavior Surveillance (NHBS)	Surveillance	National HIV Behavioral Surveillance	2012	304	n/a
(Latkin et al., 2008)	Eligibility criteria included injection drug use in the past year, willingness to participate in group education session, and sex with an opposite-sex partner in the last 3 months	Secondary HIV prevention intervention study	Data from baseline, 6 and 12 month follow up study visits	2001-2005	966	12 months
(Lesko et al., 2018)	Patients engaged HIV in continuity care	Cohort	Medical records	2010-2015	3,021	Up to 6 years
(Liappis et al., 2014)	People living with HIV at a Washington DC with a history of or ongoing substance use	Retrospective cohort	Electronic medical records	1998-2009	316; 141 PWID	Between 6 months and 11 years
(Marquez et al., 2009)	PLWH receiving care at one of UCSF's HIV primary care clinics	Cross sectional	Anonymous surveys sent to participants	2004 and 2006 recruitment	653	n/a
(Mimiaga et al., 2013)	PLWH receiving primary care services as part of the Centers for AIDS Research Network of Integrated Clinical Systems study	Ongoing observational cohort	CNICS data repository	2005-2010	Model 1: 3, 413 Model 2: 2,618 Model 3: 1,292	First clinic assessment included in CNICS
(Mizuno et al., 2015)	Eligibility criteria included living with HIV, IDU in the past year, willingness to participate in group education session, and sex with an opposite-sex partner in the last 3 months	Cross sectional analysis of a secondary HIV prevention intervention study	Baseline assessment	2001-2005	1,052	n/a
(O'Connor et al., 1992)	PWID receiving clinical care at a clinic with co-located drug treatment and HIV primary care	Program evaluation	Chart review by clinicians who were not the primary care provider of the patient under study	1990	120	1 year of chart review

(Oliva et al., 1999)	Participants were in the childbearing population, with the majority (77%) reporting injection drug use	Qualitative	6 focus group interviews	1999	63	n/a
(Ompad et al., 2004)	PWID and PWUD from two separate ongoing studies in New York City susceptible to HBV and accepted a referral for HBV vaccination	Prospective cohort	Study surveys and vaccination cards from participating clinics	August 2000-January 2004	100 PWID 42 initiated the HBV series	6 months
(Riley, Safaeian, et al., 2002)	PWID utilizing a free syringe exchange program	Cross sectional	Questionnaire administered by trained study staff	June 1998-May 1999	269	n/a
(Skeer et al., 2018)	Current or former PWID with self-reported positive HCV status	Qualitative	24 in-depth interviews	February-August 2016	24	n/a
(Westergaard et al., 2013)	PLWH and reporting IDU in the last year at baseline	Longitudinal prospective cohort	AIDS Linked Intravenous Experience; biannual data collection by study staff	1998-2011	790	Up to 13 years
(Wilkinson et al., 2006)	Eligibility criteria included living with HIV, IDU in the past year, willingness to participate in group education session, and sex with an opposite-sex partner in the last 3 months	Cross sectional analysis of a secondary HIV prevention intervention study	Baseline assessment	2001-2005	1101	n/a
(Wilkinson et al., 2007)	Eligibility criteria included injection drug use in the past year, willingness to participate in group education session, and sex with an opposite-sex partner	Secondary HIV prevention intervention study	Data from baseline, 6 and 12 month follow up study visits	2001-2005	966	12 months

Figure 2.1
PRISMA diagram
of selected studies

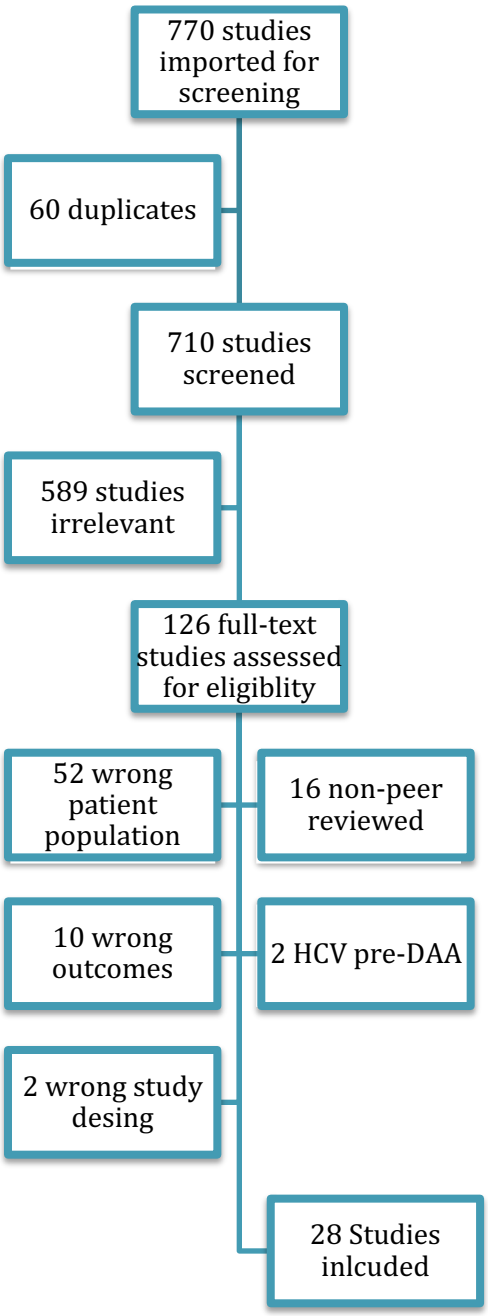

Table 2.2 Quality assessment of included articles

Reference	Assessment of selection bias	Assessment of information bias	SE, SD, or 95% CI of means reported	Multivariate analysis	Generalizability	Other quality Issues	Overall assessment of Quality
(Barocas et al., 2014)	Unlikely	Unlikely	Yes	Yes	SEP offered to a wide range of urban, suburban, and rural populations	Sampling for qualitative interviews not mixed from quantitative survey	Good
(Biello et al., 2018)	Unlikely	Unlikely	n/a	n/a	Member checking not done		Good
(Broadhead et al., 2002)	Likely	Likely	No	No	Concentrated on 14 individuals with clinician assessed poor adherence but accessed HIV primary care		Poor
(Brewer et al., 2007)	Unlikely	Unlikely	Yes	Yes	IDU was not associated with outcome in adjusted model		Fair
(Butner et al., 2017)	Likely	Unlikely	No	No	Analysis limited to only the first 75 individuals meeting treatment criteria		Fair
(Chitwood, McBride, French, & Comerford, 1999)	Unlikely	Unlikely	Yes	Yes	Representative sample of an urban IDU population		Good
(Chitwood, Sanchez, Comerford, & McCoy, 2001)	Unlikely	Unlikely	Yes	Yes	Representative sample of an urban IDU population		Good
(Chitwood, Comerford, & McCoy, 2002)	Unlikely	Unlikely	Yes	Yes	Representative sample of an urban IDU population		Good
(Hersh et al., 2011)	Likely	Unlikely	No	No	Demographics not generalizable to larger population of PWID		Fair
(Hoots et al., 2017)	Unlikely	Unlikely	Yes	Yes	National representative sample of PWID over three reporting periods		Good
(Kavasery et al., 2009)	Unlikely	Unlikely	Yes	Yes	Aging population of PWID in urban center		Good
(Kidorf et al., 2012)	Unlikely	Unlikely	Yes	No	Incentive based referral intervention may not be feasible to scale		Good
(Knowlton et al., 2010)	Likely	Unlikely	Yes	Yes	Individuals recruited from an urban centers where HIV primary care maybe different		Good
(Kuo et al., 2016)	Unlikely	Unlikely	Yes	Yes	National representative sample of PWID over three reporting periods		Good
(Latkin et al., 2008)	Likely	Unlikely	Yes	Yes	Individuals recruited from an urban centers where HIV primary care maybe different		Good

(Lesko et al., 2018)	Likely	Unlikely	No	Yes	Data stratified by PWID vs non IDU but test statistics not reported for measures of those actively injecting		Fair
(Liappis et al., 2014)	Likely	Unlikely	No	No	This analysis was restricted to those actively engaged in HIV care but comparisons are between people with active IDU to former IDU		Fair
(Marquez et al., 2009)	Likely	Unlikely	Yes	No	Findings not generalizable to general injecting population		Fair
(Mimiaga et al., 2013)	Unlikely	Unlikely	Yes	Yes	Good study design, though models were limited due to low number of PWID		Good
(Mizuno et al., 2015)	Likely	Unlikely	Yes	Yes	Individuals recruited from an urban centers where HIV primary care maybe different		Good
(O'Connor et al., 1992)	Likely	Likely	No	No	Study conducted in a pre-HAART, pre-ACA era		Fair
(Oliva et al., 1999)	Unlikely	Unlikely	n/a	n/a	Member checking not done	`	Good
(Ompad et al., 2004)	Likely	Unlikely	Yes	Yes	Older study with participants recruited from ongoing studies	Vaccine completion data not collected by study staff directly	Good
(Riley, Safaeian, et al., 2002)	Likely	Unlikely	Yes	Yes	Convenience sample of PWID from two urban based NEPs		Good
(Skeer et al., 2018)	Unlikely	Unlikely	n/a	n/a		Member checking not done	Good
(Westergaard et al., 2013)	Unlikely	Unlikely	Yes	Yes	Aging population of PWID in urban center		Good
(Wilkinson et al., 2006)	Likely	Unlikely	Yes	Yes	Individuals recruited from an urban centers where HIV primary care maybe different		Good
(Wilkinson et al., 2007)	Likely	Unlikely	Yes	Yes			Good

Table 2.3 Summary of results of included studies

Reference	Predisposing	Enabling	Need	Health Behaviors
(Barocas et al., 2014)	*Education:* Completing college or technical school associated with HCV test in the last year compared to lower level of education: aOR 1.9 (1.4-2.5).	*Insurance:* Having a primary care provider (aOR 2.0; 1.3-3.0) and health insurance (p=0.02) associated with HCV testing the past year. *Location:* Urban and Suburban had higher testing in the last 12m (p=0.05) Milwaukee zip code (aOR 2.3; 1.5-3.5). *Relationship:* Lack of rapport with provider associated with not testing (p=0.02).	*Overdose:* History of opioid overdose associated with HCV testing: aOR 1.8 (1.1-2.8).	
(Biello et al., 2018)	*Individual level:* Barriers included low PrEP knowledge and limited HIV risk perception	*Relationship* Barriers related to negative experiences with healthcare providers *Stigma:* HIV-related stigma within social networks *Capacity:* Poor infrastructure an for PrEP delivery to PWID	*Healthcare need:* Competing health priorities and needs due to drug use and dependence	
(Broadhead et al., 2002)		*Peer support:* The results suggest that an alternative social support structure to drug treatment is feasible for increasing active drug user's adherence to medical care		
(Brewer et al., 2007)				*IDU:* PWID had lower proportions of initiating HIV primary care compared to non-drug users (p<0.01) but in adjusted model injecting not associated with initiating HIV primary care
(Butner et al., 2017)		*Co-location:* 98% of participants completing treatment obtained SVR; 99% of patients adhered to HCV and OTP treatment		*IDU:* Ongoing drug use occurred in 23% of patients undergoing treatment
(Chitwood, McBride,			*Healthcare need and access:* PWID were significantly reported need for	

French, & Comerford, 1999)			care compared to NDU (aOR1.64; 1.08-2.50) and no access to care when needed (aOR 1.55; 1.13-2.12).	
(Chitwood, Sanchez, Comerford, & McCoy, 2001)				*IDU*: Associated with decreased odds of receipt of a primary physical examination (aOR 0.54; 0.37-0.79)
(Chitwood, Comerford, & McCoy, 2002)				*IDU:* Significantly negatively associated with satisfaction with access to healthcare in adjusted analysis (p<0.001)
(Hersh et al., 2011)		*Co-location:* 61% retention in care after 1 year at an office based buprenorphine program		*SU:* Reduction in toxicology positive for opioids from baseline (58%) to 1 year follow up (14%)
(Hoots et al., 2017)	Prevalence ratios comparing ART use per 3-year increase: *Sex:* Female (aPR 1.15; 1.06-1.24) Male (aPR 1.06 (1.01-1.10) *Race and Ethnicity:* Black (aPR 1.07; 1.02-1.13) Hispanic: aPR 1.10 (1.02-1.18) *Age:* Age<50 (aPR 1.09; 1.02-1.17) Age>=50 (aPR 1.07 (1.01-1.12) *Education:* HS or less education (aPR 1.10; 1.05-1.15)	Prevalence ratios comparing ART use per 3-year increase: *Insurance*: Current insurance (aPR 1.07; 1.03-1.11)		
(Kavasery et al., 2009)				*IDU:* Daily injecting associated with interruption of ART (aOR 1.43; 1.02-1.98) and early interruption of ART (aOR 1.80; 1.04-3.10). Daily or greater injecting less likely to restart ART (aOR 0.69; 0.49-0.97)
(Kidorf et al., 2012)		*Linkage:* PWID in MRC+I were more likely to enroll in methadone treatment compared to MRC only (aOR 2.29; 1.23-4.24) and SRC (aOR 2.52; 1.36-4.75); MRC+I were more likely to report more days in drug treatment compared to		*IDU:* MRC+I were significantly more likely to report less heroin use and injecting in the last 30 days compared to MRC only and SRC (p<0.001)

		MRC only (p<0.001) and SRC (p<0.001)		
(Knowlton et al., 2010)	*Age:* Older age associated with taking ART (aOR 1.03; 1.00-1.05) *Education:* Self-report education <8th grade associated with lower odds of taking ART (aOR 0.54; 0.35-0.85)	Predictors of taking ART: *Insurance*: aOR 2.13(1.40-3.25) *Stable Housing*: aOR 2.05 (1.11-3.77) *Relationship:* Patient-provider engagement rated as perfect (aOR 1.45; 1.09-1.93)	*Disease stage*: CD4<350 associated with taking ART (aOR1.65; 1.23-2.22) *Care visits:* Greater than 4 visits in the last 6 months associated with taking ART (aOR 1.44; 1.09-1.91)	*SU*: Drug use in the last 3 months associated with lower odds of taking ART (aOR 0.67; 0.50-0.90)
(Kuo et al., 2016)	*Age:* Younger PWID (<50) were more likely to report willingness to use PrEP (aOR 3.05; 1.44-6.50)			*Harm reduction:* Those who shared works in the last year were significantly more likely to report willingness to use PrEP (aOR 3.47; 1.71-5.06);
(Latkin et al., 2008)		*Peers:* Norms for safer drug use associated with decreased odds of sharing injection equipment (aOR 0.92; 0.86-0.98)	*Psychiatric:* Higher levels of psychological distress associated with a greater likelihood of drug paraphernalia sharing (aOR 1.34; 1.01-1.79) *Care visit:* HIV primary care visit in the last 6 months associated with decreased odds of sharing injection equipment (aOR0.48; 0.27-0.85)	
(Lesko et al., 2018)	*Sex and race:* White females had the lowest % time in care post ART (88.5%), and both White and Black female PWID had the greatest % of time in care with viral load >1500 copies (21.6%) and time in care post-ART with a viral load >1500 copies (White 15.9%; Black 18.7%)			
(Liappis et al., 2014)		*Housing:* Active IDU were more likely to report homelessness (61%) (p<0.001) compared to non-active IDU	*Comorbidities:* Active IDU were more likely to be smokers (93%) (p<0.001), in a methadone program (63%) (p<0.001), have comorbid HBV (88%) (p<0.001), HCV (95%) (p<0.001), Stroke (6%) (p=0.05), DVT/PE (12%) (p<0.001), multiple BSI (13%) (p<0.02), and less likely to be on ART (68%vs 82% p=0.003), and have an	

			undetectable viral load (31% vs 43% (p=0.02) compared to non-active IDU	
(Marquez et al., 2009)				*IDU:* The only route of use associated with poor adherence in methamphetamine users was injection (PR: 2.1, 95% CI: 1.0-4.6)
(Mimiaga et al., 2013)	*Age:* PWID were less likely to be older (p<0.01) *Race:* PWID were less likely to be Black (aOR 0.26; 0.16-0.42)		*Comorbidities:* PWID higher odds of major depression (aOR 2.19; 1.75-2.73) and report drug treatment (aOR 5.00; 4.03-6.20)	*IDU:* More likely to have a detectable viral load (aOR 1.48; 1.15-1.90), higher non adherence scores (aOR 1.44; 1.27-1.63),
(Mizuno et al., 2015)			Report of 1 (aOR 2.03; 1.20-3.43), 2 (aOR 2.07; 1.24-3.44), 3 (aOR 2.79; 1.63-4.78), and 4-6 (2.47 (1.41-4.30) problems (vs. no problems) were all associated with not currently taking HIV medication. 3 problems (aOR 3.34; 1.01-5.42) and 4 problems (aOR 2.56; 1.07-2.63) were associated with non-adherence to HIV medication (<90%) in the previous day); 4 problems was associated with a detectable HIV viral load (aOR 2.24; 1.18-4.27)	Those with 3 problems (aOR 2.12; 1.16-3.89) and 4 problems (aOR 4.85; 2.62-9.00) were more likely to reports sharing works with HIV negative or unknown status partners in the last 3 months
(O'Connor et al., 1992)		*Co-location:* PWID enrolled in the CMU had high uptake of ART (84%), prophylaxis for pneumocystis pneumonia (77%), and screening for TB (87%), Syphilis (100%), and Hepatitis B (100%)		
(Oliva et al., 1999)		*Healthcare barriers identified*: The high cost of health care, perceived poor quality of care and experiences of discrimination and stigmatization, geographic accessibility, fear of legal/social services punitive actions		
(Ompad et al., 2004)				*IDU:* Daily injectors (42%) and injectors in the last 6 months (42%) were less likely to initiate the vaccine

				series (p=0.03); 16% of daily and 36% of injectors in the last 6 months were less likely to complete vaccine series (p=0.02) compared to non-injectors. Daily injectors were less likely to complete the vaccine series (aOR 0.28; 0.09, 0.88)
(Riley, Safaeian, et al., 2002)	*Age:* Older age (>39) was associated with primary care utilization in the last 3 years (aOR 1.82; 1.09-3.05) *Race:* Black race associated with lower odds of utilizing drug treatment in the last 3 years (aOR 0.41; 0.21-0.78) *Employment:* Unemployment associated with higher odds of drug treatment in the last 3 years (aOR 2.72; 1.08-6.84)	*Insurance:* Associated with primary care utilization in the last 3 years (aOR 2.16; 1.20-3.86) and drug treatment in the last 3 years (aOR 2.05; 1.19-3.56)		*Harm reduction:* Exchanging more than 7.5 syringes per NEP visit was associated with primary care utilization in the last 3 years (aOR 2.45; 1.46-2.33)
(Skeer et al., 2018)		Themes regarding social determinants of engagement in HCV treatment	Themes regarding illness level for accessing HCV treatment	
(Westergaard et al., 2013)				*IDU:* Injection associated with lapses in HIV care (aOR 1.25; 1.06-1.49) and virologic failure (aOR 1.28; 1.02-1.61)
(Wilkinson et al., 2006)	*Race and Ethnicity:* Hispanic (aOR 2.28; 1.37-3.82) and non-Hispanic Black (aOR 2.22; 1.71-2.89) compared to non-Hispanic Whites *Education: H*igh school or less education (aOR 1.86; 1.27-2.72), were more likely to report a prevention discussion at the most recent care visit		*Care visits:* Rating HIV care very important (aOR 1.77; 1.31-2.37) and engagement with a provider (aOR 1.74; 1.17-2.57) associated with prevention discussion	
(Wilkinson et al., 2007)	*Self efficacy:* Increase in importance of HIV care scale score (OR = 5.65; P = 0.01) increased empowerment (OR = 2.42; P = 0.005), taking greater control of one's health (OR = 2.17; P = 0.001), were significantly associated with reporting 2 or more primary HIV care visits in the past 6 months.	*Health insurance*: Associated with primary HIV care visits (OR = 2.58; P = 0.003) *Case management:* Associated with primary HIV care visits (OR = 3.14; P = 0.027)	*Disease stage:* CD4 count <200 cells/mm3 (OR = 2.09; P = 0.007) was significantly associated with primary HIV care visits	

CHAPTER 3: Classes of multimorbidity indicate differential patterns on healthcare engagement for an older population of current and former people who inject drugs.

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Abstract

People who inject drugs (PWID) are an aging population, with complex health needs. Care for multimorbid diseases may be complicated by ongoing substance use and inconsistent access to health care in this population. However, little is known about multimorbidity and its effect on healthcare engagement for this population. The purpose of this study is to characterize classes of multimorbidity for a population of PWID, identify the individual, health behavior, and structural characteristics associated with each multimorbidity class, and determine the relationship of these classes with healthcare utilization and health event outcomes. We found three classes of multimorbidity: *Low Multimorbidity, Multimorbidity, and Multimorbidity with Psychiatric Comorbidity.* Nearly 75% of the sample fell into the classification of having *Multimorbidity* or *Multimorbidity with Psychiatric Comorbidity*. Individuals in each of these groups had extremely high conditional probabilities of all of the diseases we considered with the key distinction of additional psychiatric comorbidity in one group. These groups were significantly more likely to receive disability and had higher healthcare utilization than the *Low Multimorbidity* group. While these findings are not unexpected, there are resulting consequences for the health care system and the affected individuals. Holistic healthcare systems can address these needs best with integrated care systems that provide for harm reduction, co-location with substance use and mental health treatment, and wrap around services, particularly as this population continues to age.

Introduction

People who inject drugs (PWID) are an aging population, with complex health needs. Treatment guidelines and healthcare services designed to provide care to adults who inject drugs often limit the scope of their guidelines to infectious disease treatment and prevention, soft tissue infections, and harm reduction, with little attention paid to engagement in healthcare for treatment of chronic diseases (Centers for Disease Control and Prevention, 2012; Low et al., 2016; Visconti, Sell, & Greenblatt, 2019). However, for PWID, multimorbidity, defined as presence of two or more co-occurring diseases, is common and under addressed (Johnston, Crilly, Black, Prescott, & Mercer, 2019). Data from a community cohort of current and former PWID in Baltimore, the AIDS Linked Intravenous Experience (ALIVE) study, found high prevalence of diabetes (8%), obstructive lung disease (19%), liver disease (22%), kidney dysfunction (27%), and hypertension (38%) (Salter, Lau, Go, Mehta, & Kirk, 2011). Moreover, these conditions co-occurred in 58% of PWID. Multimorbid diseases in this study population were largely undiagnosed or undertreated, suggesting that care needs of this group are complex and impact healthcare utilization (Piggott et al., 2013, 2016; Salter et al., 2011).

Gruman and colleagues (2010) define engagement in healthcare as, "actions individuals must take to obtain the greatest benefit from the healthcare available to them." Increased healthcare utilization leads to improved health outcomes for substance use disorder and reduced cost to health systems (Chi, Parthasarathy, Mertens, & Weisner, 2011; Park, Cheng, Samet, Winter, & Saitz, 2015; Parthasarathy, Chi, Mertens, & Weisner, 2012). However, PWID utilize outpatient healthcare at low rates, emergency and inpatient care at higher rates, and are often seen in later stages of disease (Artenie et al., 2015; Larney et al., 2017; Mizuno et al., 2015; Okeke, Ostermann, & Thielman, 2015; Oramasionwu, Moore, & Toliver, 2014; Osilla et al.,

2011; Strathdee, Shoptaw, Dyer, Quan, & Aramrattana, 2012; Thompson, Mugavero, Amico, & Cargill, 2018; Westergaard, Hess, Astemborski, Mehta, & Kirk, 2013). Limited access and barriers that exist within the healthcare infrastructure drive this lack of engagement. Insurance status, sex, lack of health insurance, poor provider continuity, active substance use, and stigma are predictors of poor utilization and healthcare engagement (Hartzler et al., 2018; Westergaard et al., 2013; Westergaard, Kirk, Richesson, Galai, & Mehta, 2011).

On the flip side, there are a number of factors that have been demonstrated to facilitate healthcare access and engagement. Medication for opioid use disorder (MOUD), integrated care services, and focused retention interventions have a positive association with engagement in care (Islam et al., 2013; Jack, Willott, Manners, Varnam, & Thomson, 2009; Mehta et al., 2015; Miller et al., 2018; Morozova, Dvoriak, Pykalo, & Altice, 2017; Parmenter et al., 2013; Wang et al., 2013). However, no study to date has examined the impact of multimorbid chronic diseases on primary care engagement for PWID.

Latent Class Analysis (LCA) is a useful method to highlight nuanced patterns of multimorbidity by exploring how diseases co-occur among PWID (Lanza & Rhoades, 2011). Additionally, this method can show associations of individual, structural, and health behavior characteristics with underlying multimorbidity classes, which have implications for engagement in care (Lanza & Rhoades, 2011). The Behavioral Model for Vulnerable Populations, adapted from the Andersen Model of Healthcare Utilization, was selected as the framework for this analysis. The model posits Predisposing, Enabling, Need, and Health Behavior based factors that influence primary care utilization and engagement (Andersen, 1968; Gelberg, Andersen, & Leake, 2000), which were used to guide LCA, its interpretation, and to position finding's implications for care.

Using classes of multimorbid diseases to build understanding of holistic healthcare needs, it is possible to inform interventions and integrated care systems that reduce drug use, provide a pathway to cessation or avenues for harm reduction, and address chronic diseases. The purpose of this study was to characterize classes of multimorbidity for a population of PWID, identify the individual, health behavior, and structural characteristics associated with each multimorbidity class, and determine the relationship of these classes with healthcare utilization and health event outcomes to inform integrated and holistic healthcare for this aging population.

Methods

Study Population

Data were derived from the AIDS Linked Intravenous Experience (ALIVE), a population-based cohort study with current and former people who inject drugs in Baltimore, MD. The ALIVE study was first established in 1988 to characterize the incidence and natural history of HIV among PWID (Vlahov et al., 1991). Subsequent recruitment waves of new participants occurred during 1994-1995, 1998, 2005-2008, and 2015-2018. Eligibility criteria included being 18 years or older and a history of injection drug use. Participants underwent biannual visits with an interview, clinical examination, and biospecimen collection. All participants provided written informed consent prior to participation in the study. The Johns Hopkins Bloomberg School of Public Health Institutional Review Board approved study procedures. This analysis utilized data collected between 2014-2018. Participants with at least one study visit in 2014 and 2018 were included. Across the 9 possible study visits between the January 2014 and June of 2018, participants included in the final analysis had a mean of 8 visits (Std. Dev. 1.06). Of the 921 individuals with at least one study visit in 2014, 604 had a study by the end of June 2018, and were included in this analysis. Compared to those included in analysis,

those who only had a study visit in 2014 were significantly less likely to report a baseline emergency room visit ($p=0.006$) and less likely to be Black race (92% vs. 84%; $p<0.001$) but were otherwise similar on other characteristics of sex and baseline income, disability status, outpatient healthcare utilization, insurance, and substance use.

Communicable Disease Indicators

Indicators for latent class analysis were the presence or absence of chronic diseases commonly treated in the outpatient clinical setting.. Individuals were classified as ever having each disease based on responses at the longitudinal study visits using the established criteria described below:

Arthritis: Self-report of diagnosis of or treatment for arthritis at a study visit during a study visit between 2014-2018.

Anxiety/Depression: Self-report of diagnosis or treatment for anxiety at any study visit between 2014-2018, or a Centers for Epidemiologic Studies Depression Scale (CES-D) score of 23 or greater at two or more study visits, indicating persistent major depressive symptoms (Carleton et al., 2013).

Diabetes: Self-report of medications for diabetes or a Hemoglobin A1c (HbA1c) value 6.5% or greater for any specimen collected between 2014-2018.

Hypertension: Self-report of medications for hypertension at any visit or blood pressure readings of systolic>= 140 or diastolic>=90 at two or more study visits between 2014-2018.

Human Immunodeficiency Virus: Self-report of antiretroviral therapy (ART) at any visit or confirmed HIV antibody at any study visit through 2018, including those before 2014.

Liver Fibrosis (Severe and Cirrhotic): Based on the median value of liver stiffness from transient elastography (FibroScan) measurements taken at each study visit between 2014-2018.

Participants were classified based on cutoffs for F3 severe fibrosis (kPa >=9.5) or F4 cirrhosis (kPa>=12.5) (Kirk et al., 2009), and collapsed into one dichotomous variable.

Major Psychiatric Disorders: Self-report of medications or diagnosis for bipolar disorder, schizophrenia, or schizoaffective at a study visit between 2014-2018.

Obstructive Airway Disease: Ratio of the forced expiratory volume in 1 second to forced vital capacity of <=70% at two or more study visits between 2014-2018.

Renal Dysfunction: Self-report of treatment for renal dysfunction or an estimated glomerular filtration rate <60 mL/min/1.73 m^2 using the MDRD equation at any study visits between 2014-2018.

Covariates associated with class membership

Covariates were selected based on characteristics described by Behavioral Model for Vulnerable Population as salient to healthcare utilization and engagement.

Predisposing

Baseline age: Measured as a continuous variable at the first study visit in 2014 and transformed into a dichotomous variable. We split the variable near the median age of this study sample, 55 years old.

Sex: A dichotomous variable comparing self-report male vs. female sex.

Race: Classified as Black compared to non-Black race.

Enabling

Baseline income: Measured as a dichotomous variable at the first study visit in 2014 comparing individuals with an annual income less than $5,000 dollars per year to those with an income greater than $5,000 per year.

Baseline disability: Measured as a dichotomous variable at the first study visit in 2014 based on the following question: "Currently, are you receiving SSI (Supplemental Security Income) or SSDI (Social Security Disability Income), or any other type of disability?"

Baseline insurance: Self-report health insurance in the last six months at the first study visit in 2014

Continuity of care: Self-report of healthcare visits with the same healthcare provider for the last 2 years at the first visit in 2014

Health Behaviors

Baseline substance use: To capture substance use and route of administration, we combined baseline self-report of heroin, cocaine, crack, and/or speedball in the last 6 months into the following categories: Injection only, non-injection only, both injection and non-injection, with no substance use as the reference category.

Baseline alcohol use: Binary variable for self-report of any alcohol use in the last 6 months.

Baseline cigarette use: Binary variable for self-report of any cigarette use in the last 6 months.

Health events and healthcare utilization

Infectious events: Self-report of diagnosis or treatment for sepsis, pneumonia, endocarditis or skin infection in the last 6 months at a study visit between 2014-2018

Cardiovascular events: Self-report of diagnosis or treatment for myocardial infarction, heart failure, heart disease, or stroke in the last 6 months at a study visit between 2014-2018

Emergency room visit: Self-report of utilization of emergency room services in the last six months at the last study visit in 2018

Outpatient visit: Self-report of utilization of outpatient healthcare services in the last 6 months at the last study visit in 2018

Medication for opioid use disorder: Self-report of prescription of buprenorphine, naltrexone, or methadone in the last 6 months at the last study visit in 2018

Statistical analysis

Data cleaning and variable transformation as well as logistic regression to examine the effect of multimorbid disease class on healthcare utilization and health events was conducted in Stata 16 (StataCorp, 2019). Latent class analysis and predictors of regressions to classify predictors of class membership were conducted using Mplus Version 8 software (Muthen & Muthen, 2011). LCA was used to explore underlying classes of multimorbid disease clustering. The Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), sample size adjusted Bayesian Information Criteria (aBIC), Lo-Mendell-Rubin adjusted likelihood ratio test (LMR-LRT), and Bootstrapped likelihood ratio test were utilized to evaluate the optimal number of multimorbid diseases classes (Nylund, Asparouhov, & Muthen, 2007). Conditional probabilities for each disease indicator specify the probability of presence of that disease for the given class (Nylund et al., 2007). Interpretability of the classes based on the conditional probabilities of disease indicators and entropy of class membership were also considered in selecting the final class structure (Celeux & Soromenho, 1996).

Following the identification of the optimal number of classes, predisposing, enabling, and health behavior characteristics were included as covariates with unadjusted regression using the R3STEP function in MPlus, which examines that covariate's correlation with a multimorbidity class, relative to a reference class. The reference for all models was the class with the lowest percent of multimorbid diseases. *A priori* variables of age, sex, insurance, and substance use were selected for the final adjusted model regardless of statistical significance based on the conceptual framework (Gelberg et al., 2000). Additionally, enabling variables with statistically

significant unadjusted associations ($p<0.02$) with either class were selected for the adjusted model. Finally, the effects of multimorbid class on dichotomous outcomes of healthcare utilization and health events were examined using logistic regression, controlling for associated predisposing and enabling characteristics.

Results

Demographic characteristics

Of the 604 individuals included in this analysis, the majority were male sex (65%) and Black race (92%). At baseline, the mean age was 54 years old (IQR=8.6). Less than half reported an annual income greater than $5,000 (34%), and a high percentage reported filing for disability (84%). Only 5% of the study sample reported being uninsured in the last 6 months at baseline, with 70% reporting coverage with Medicare or Medicaid. At baseline, 38% of this study population reported substance use in the previous 6 months, with equal proportions reporting non-injection use only (43%) or both injection and injection use (42%); only a small proportion of those reporting substance use at baseline used injection drugs exclusively (14%). Almost a quarter of the participants reported using emergency room services in the previous 6 months and three quarters utilizing outpatient healthcare services. Finally, at the first visit in 2014, 70% of participants had evidence of two or more multi-morbid diseases used as indicators for latent class analysis.

Model Selection

A comparison of model fit indices indicated that a three-class solution was optimal (Table 2). HIV was the only disease indicator dropped from analysis, as its conditional probabilities were similar in each class; model fit and interpretability improved with its exclusion. Additionally, HIV and viral load status were examined as covariates of class

membership, but neither was associated with class membership. Information criteria (AIC, BIC, and aBIC) were lowest for a three-class solution. Additionally, the LMR/LTR and Bootstrapped LRT indicated a three-class solution significantly improved fit compared to two classes, and fit did not significantly improve when adding a fourth class (Nylund et al., 2007). A three-class solution and its interpretability highlighted the following patterns of multimorbidity classes: Class 1 (*Low Multimorbidity*), Class 2 (*Multimorbidity*), and Class 3 (*Psychiatric Comorbidity*). Class 3 was the largest with 42% (N=251) of the participants, followed by Class 2 (N=190, 31%) and Class 1 (N=163, 27%).

Latent Class Analysis

Table 3 lists the percent of people with of each disease indicator for the three multimorbid classes based on the percentage. Across the three classes, there were similar conditional percentages of obstructive airway disease. The *Low Multimorbidity* class (Class 1) had a high conditional probability of hypertension as well (67%), but this was still substantially lower than the probability of hypertension in the *Multimorbidity* class (93%) and *Multimorbidity with Psychiatric Comorbidity* class (83%). The *Multimorbidity* class had higher percentage of all diseases compared to the other two classes except for the two psychiatric indicators. In particular, individuals in the *Multimorbidity* class had substantially higher probability of severe liver fibrosis/cirrhosis compared to the *Multimorbidity with Psychiatric Comorbidity* class (53% vs. 42%) and the *Low Multimorbidity* class (53% vs. 31%). This *Multimorbidity* class also had markedly higher probabilities of diabetes compared to the other two classes, with a 32-percentagentage point higher probability compared to the *Low Multimorbidity* class (36% vs. 4%). The *Multimorbidity with Psychiatric Comorbidity* class had distinct probabilities of major psychiatric disorder and anxiety/depression. There was a 100% probability of anxiety and/or

depression for individuals in this class, which was approximately 80-percentage points higher than the *Multimorbidity* and *Low Multimorbidity* classes. This class also had a 79% probability of a major psychiatric disorder (bipolar disorder or schizophrenia), 63 percentage points higher than the *Low Multimorbidity* class (16%) and 67 percentage points higher than the *Multimorbidity* class.

Baseline correlates of class membership

Table 4 shows the correlates of class membership relative to class 1, *Low Multimorbidity*. The *Low Multimorbidity* class did not differ from either of the other two classes on race, baseline continuity of care with a provider, alcohol, and cigarette use in bivariate analyses and these variables were not included in the final model. In unadjusted models, individuals in the *Multimorbidity* class were significantly more likely to be receiving disability at baseline and be insured compared to individuals in the *Low Multimorbidity* class. In the adjusted model, individuals in the *Multimorbidity* class had 5.9 higher odds of baseline disability (95% CI 2.36-14.54) compared to the *Low Multimorbidity* class. Additionally, individuals in the *Multimorbidity* class in the adjusted model were significantly less likely to report injecting drugs compared to the *Low Multimorbidity* class (aOR 0.16 95% CI 0.03-0.99). Individuals in the *Multimorbidity with Psychiatric Comorbidity* class were significantly more likely to be female than the *Low Multimorbidity* class (aOR 5.75 95% CI 1.65-20.13). Similar to the *Multimorbidity* class, persons in the *Multimorbidity with Psychiatric Comorbidity* class had significantly higher unadjusted and adjusted odds of baseline disability compared to the *Low Multimorbidity* class (aOR 7.7 95% CI 3.2-18.7). Finally, those in this class had 2 times higher odds of a baseline income less than $5,000 (95% CI 1.12-3.99) but this did not retain statistical significance in the adjusted model.

Differences in healthcare utilization and health events

Table 5 displays odds ratios of associations between class membership and healthcare utilization and health event outcomes, using the *Low Multimorbidity* class as the reference and controlling for baseline age, sex, race, income, disability, care continuity, and substance use in the adjusted logistic regression model. Compared to those in the *Low Multimorbidity* class, persons in the *Multimorbidity with Psychiatric Comorbidity* class had significantly higher odds of an infectious disease health event (OR 1.88; 95% CI 1.21-2.91), but this did not retain its statistical significance in the adjusted model (aOR 1.56; 95% CI 0.97-2.52). Individuals in the *Multimorbidity with Psychiatric Comorbidity* class had significantly higher adjusted odds of emergency room visits (aOR 1.77; 95% CI 1.03-3.02) compared to the *Low Multimorbidity* class. Persons in the *Multimorbidity with Psychiatric Comorbidity* class (aOR 1.76; 95% CI 1.04-2.98) and *Multimorbidity* class (aOR 2.00; 95% CI 1.15-3.49) both had significantly higher odds of outpatient healthcare utilization compared to the *L*ow *Multimorbidity* class. Finally, those in the *Multimorbidity with Psychiatric Comorbidity* had significantly higher odds of a prescription for medication for opioid use disorder than the *Low Multimorbidity* class (aOR 1.97; 95% CI 1.25-3.09).

Discussion

Our study identified three distinct classes of multimorbidity in an aging cohort of current or former PWID. Moreover, nearly 75% of the sample were classified as having *Multimorbidity* or *Multimorbidity with Psychiatric Comorbidity*. Individuals in each of these two groups had very high co-occurring probabilities of all of the diseases we considered with the key distinction of additional psychiatric comorbidity in one group. These groups were significantly more likely

to receive disability, and had higher healthcare utilization, while, while not unexpected, had consequences for the healthcare system and these individuals.

Multiple studies have examined multimorbidity profiles in the general aging population using this approach (Gellert et al., 2019; Hall et al., 2018; Hustoft et al., 2013; Islam et al., 2014; Olaya et al., 2017; Park, Lee, & Park, 2019; Whitson et al., 2016). While those studies and this differ in their selection and measurement of diseases, their findings, like ours, demonstrated heterogeneity in multimorbidity. Two studies (Gellert et al., 2019; Olaya et al., 2017) noted increased utilization of healthcare services by latent classes with increased multimorbid diseases; one study (Whitson et al., 2016) also noted differential utilization of healthcare services by multimorbidity class. Their findings, however, still confirm the heterogeneity of multimorbidity and associated characteristics, allowing for nuanced understanding of multimorbidity with implications for future interventions.

The *Low Multimorbidity* class was the smallest of the three described here. This class has been described as the "healthy" class in previous studies (Islam et al., 2014; Larsen, Pedersen, Friis, Glumer, & Lasgaard, 2017; Olaya et al., 2017; Park et al., 2019; Whitson et al., 2016) due to its low probability of all diseases under study. While set as the reference group for analysis of associations with class membership, this class was significantly more likely to be uninsured in unadjusted analysis with the other two classes. This association was not noted in other studies, though many of were conducted in settings outside the United States with universal healthcare coverage. Therefore, health insurance was not considered. Longitudinal analyses within ALIVE have previously demonstrated that health insurance coverage was associated with significantly increased prescription of medication for opioid use disorder and continuity with a healthcare provider (Feder et al., 2019). Additionally, this class had a high probability of hypertension

(67%) compared to other studies (Islam et al., 2014; Larsen et al., 2017; Olaya et al., 2017; Park et al., 2019). The absence of a class with low probabilities of all diseases might be related to our selection criteria of individuals having at least two of the selected diseases as an inclusion criterion. Given this and the high probabilities of severe liver fibrosis (31%) and obstructive airway (31%) compared to the national prevalence, there is still a demonstrated need for this population to be engaged in regular care with semi-annual or annual health assessments and screenings (Singal et al., 2009; Visconti et al., 2019).

The *Multimorbidity* class was the second largest and was characterized by high probabilities of all non-psychiatric diseases. The disease makeup of this class could not be directly compared with other published studies as their multimorbidity classes provided more granular identification of classes based on specific diseases due to their higher sample sizes (Islam et al., 2014; Larsen et al., 2017; Olaya et al., 2017; Park et al., 2019; Whitson et al., 2016). Previous studies with this cohort also demonstrated the decreased odds of injection drug use with increased multimorbidity (Salter et al., 2011). The decreased odds of injecting for this group could be related to the increased utilization of outpatient care, though only the association of active injection on lower utilization has been previously demonstrated (Maragh-Bass, Powell, Park, Flynn, & German, 2017). The increased odds of outpatient healthcare utilization by this class were also seen in similar classes with multimorbidity that did not include a psychiatric comorbidity (Gellert et al., 2019; Olaya et al., 2017; Whitson et al., 2016). Taken together, the Behavioral Model would indicate alignment of perceived and actual healthcare need, as participants in this class were more likely to utilize outpatient healthcare services in the last six months compared to the *Low Multimorbidity* class, which had a decreased perceived and actual need (Gelberg et al., 2000).

The *Multimorbidity with Psychiatric Comorbidity* was the largest class with similar high disease probabilities to the *Multimorbidity* class, but unique with its high probabilities of major psychiatric disorders and anxiety/depression. While measured inconsistently across studies, analyses that included at least one mental health diagnosis noted one distinct class with a psychiatric co-morbidity (Islam et al., 2014; Larsen et al., 2017; Olaya et al., 2017; Park et al., 2019). This class was the only one significantly associated with a predisposing characteristic, female sex (aOR 5.75; $p<0.001$). This was also noted in national reporting of mental health disorders with women having higher prevalence of any mental illness, depression/anxiety, and severe mental illness (Bose, Hedden, Lipari, & Park-Lee, 2018). The *Multimorbidity with Psychiatric Comorbidity* was also notable for being the only class associated with an infectious disease event between 2014-2018 in bivariate analysis, though significance was lost in the adjusted model. Additionally, this class had much higher odds of all measures of healthcare utilization. It was the only class with higher odds of receipt of MOUD and outpatient healthcare utilization. Other studies with PWID have also demonstrated co-location of MOUD with primary and outpatient care as a factor correlated to engagement (Islam et al., 2013; Jack et al., 2009b; McNeil, Small, Wood, & Kerr, 2014; Mehta et al., 2015; Morozova, Dvoriak, Pykalo, & Altice, 2017b; Parmenter et al., 2013b; Wang et al., 2013). Structurally, multiple studies have also documented the increase in receipt of medication for opioid use disorder following passage of the Patient Protection and Affordable Care Act, especially for states which expanded Medicaid services (Feder et al., 2017; Tormohlen et al., 2019). Participants in this class benefit from expansion of healthcare and guaranteed coverage of MOUD services in this legislation. Finally, while this class had the highest odds of outpatient care and MOUD utilization, it was the only class also associated with emergency room utilization. This may indicate unmet need, possibly

related to one of the psychiatric co-morbidities (Gelberg et al., 2000). One study determined severity of mental health disorders significantly associated with increased utilization of emergency room services (Niedzwiecki, Sharma, Kanzaria, McConville, & Hsia, 2018) with another systematic review showing that attempted suicide or self-harm as potential drivers of this utilization (Barratt et al., 2016). Based on our data and available evidence, closer follow up with individuals in this class with integrated mental health with other outpatient healthcare services, including wrap-around case management, would be most appropriate.

There are limitations to this study. While diseases are measured over a five-year period and most with a physiological or biological marker to confirm diagnosis, there were still some disease states that were classified by self-report alone. This is particularly a limitation with severe psychiatric disorders, though classification was based on self-report of diagnosis or prescription of a medication. There was also overlap with measurement of diseases over the five-year period and the healthcare utilization and health event data, limiting the temporality of associations. However, this study's purpose was to determine the holistic needs of an aging population of PWID rather than to infer causality of multimorbidity class on healthcare engagement. Our study's restriction to participants with study visits in 2014 and first visit in 2018 limited the sample size, though sensitivity analysis with all participants with a 2014 visit only also indicated a similar 3 class structure of multimorbidity. Latent class analysis and finite mixture modeling can be useful tools in determining heterogeneity of multimorbidity, but future studies should attempt to select diseases and classify their states based on an established criterion. One study utilized the Charlson Comorbidity Index when selecting diseases and its measurement, a potential standard for future comorbidity studies (Islam et al., 2014). Because this data was from an aging population of largely Black, male, and urban population, its findings

are not generalizable to the larger population of PWID. Future studies should attempt to classify based on severity of disease states and utilize longitudinal data to determine how classes of multimorbid disease management change over time.

As a current or former PWID seek healthcare, their needs extend beyond the traditional realms of substance use. This study demonstrates heterogeneity in multimorbidity for PWID with distinct latent classes. Two of these classes of multimorbidity indicate greater healthcare need and a need for interventions to improve engagement. Additionally, there is a large subsample of the population that has an even greater need for care due to co-occurring mental health disorders. Clinicians can capitalize on the characteristics and implications for each class, tailoring follow-up and care services to clearly address the needs of multimorbidity classes. Holistic healthcare systems can address these needs best with integrated care systems that provide for harm reduction, co-location with substance use and mental health treatment, and wrap around services, particularly as this population continues to age.

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Table 3.1 Study sample baseline characteristics, 604 ALIVE participants with a study visit in 2014 and 2018.		
Predisposing characteristics		
Age, median (range)	54	(28-73)
Female sex	212	(35%)
African-American race	556	(92%)
Enabling characteristics		
Annual income < $5,000	398	(66%)
Disability	508	(84%)
Insurance last 6 months	571	(95%)
Same provider the last 2 years	376	(63%)
Health behaviors: Substance use in the last 6 months		
Any drug use*	228	(38%)
Injection drug use only	33	(5%)
Non-injection only	98	(16%)
Both injection and non-injection	97	(16%)
Alcohol	300	(50%)
Cigarettes	458	(76%)
Healthcare utilization in the last 6 months		
Emergency Room Visit	142	(24%)
Outpatient Clinic Visit	465	(77%)
Medication for Opioid Use Disorder (Methadone, Buprenorphine, Naltrexone)	235	(39%)
Need characteristics: Comorbidity prevalence		
HIV	192	(32%)
Diabetes	89	(15%)
Hypertension	387	(64%)
Renal Disease	42	(7%)
Arthritis	197	(33%)
Major Psychiatric comorbidity (Bipolar or Schizophrenia)	160	(26%)
Anxiety/Depression	212	(35%)
Fibrosis (F3/F4)**	113	(25%)
Obstructive Airway Disease***	94	(20%)

*Injection or non-injection use of heroin, cocaine, crack, and/or speedball
** Fibroscan available for 444 individuals in 2014
*** FEV only available for 464 individuals in 2014

Table 3.2 Latent Class Model Fit Statistics of 8 disease indicators, from a sample of ALIVE participants (n=604) from 2014-2018							
Model	**Log-Likelihood**	**AIC**	**BIC**	**aBIC**	**Entropy**	**LMR/LRT Test**	**Bootstrapped Likelihood Ratio Test**
1	-3100.7	6219.4	6259.1	6230.4			
2	-3004.6	6047.2	6130.8	6070.5	0.75	0.000	0.000
3	-2809.8	5671.7	5786.2	5703.6	0.65	0.04	0.000
4	-2957.2	5992.5	6164.2	6040.4	0.67	0.31	0.67

Table 3.3 Latent classes of multimorbidity classified by individual disease indicators, n=604 ALIVE participants from 2014-2018			
	Class 1 n=163 (27%) Low multimorbidity	Class 2 n=190 (31%) Multimorbidity	Class 3 n=251 (42%) Multimorbidity with psychiatric comorbidity
Arthritis			
No	99%	42%	41%
Yes	1%	58%	59%
Major Psychiatric Disorders (Bipolar and Schizophrenia)			
No	84%	88%	21%
Yes	16%	12%	79%
Anxiety/Depression			
No	77%	79%	0%
Yes	23%	21%	100%
Diabetes			
No	96%	64%	77%
Yes	4%	36%	23%
Liver Fibrosis (Severe and Cirrhotic)			
No	69%	47%	58%
Yes	31%	53%	42%
Hypertension			
No	33%	7%	17%
Yes	67%	93%	83%
Obstructive Airway			
No	69%	69%	70%
Yes	31%	31%	30%
Renal Dysfunction			
No	97%	70%	76%
Yes	3%	30%	24%

Table 3.4 Estimates of class membership with baseline characteristics (relative to low multimorbidity class), n=604 ALIVE participants from 2014-2018				
Class	Multimorbidity		Multimorbidity including psychiatric comorbidity	
Covariate	**OR (95% CI)**	**aOR (95% CI)**	**OR (95% CI)**	**aOR (95% CI)**
Predisposing characteristics				
Age >55 years	1.62 (0.82-3.18)	1.25 (0.56-2.80)	0.57 (0.31-1.04)	0.55 (0.26-1.17)
Female	2.57 (0.95-6.96)	2.99 (0.79-11.31)	**5.60 (2.32-13.53)**	**5.75 (1.65-20.13)**
African-American	1.32 (0.30-5.88)		0.48 (0.15-1.48)	
Baseline enabling variables				
Income < $5,000/year	0.80 (0.41-1.60)	0.67 (0.28-1.57)	**2.12 (1.12-3.99)**	1.58 (0.69-3.63)
Disability	**3.02 (1.45-6.27)**	**5.86 (2.36-14.54)**	**4.34 (2.26-8.35)**	**7.73 (3.20-18.67)**
Insurance (last 6 months)	**5.89 (2.04-16.95)**	3.67 (0.92-14.65)	5.89 (2.04-16.95)	5.27 (0.75-37.20)
Continuity of care	1.07 (0.54-2.14)		1.10 (0.60-1.99)	
Baseline health behaviors: Substance use in the last 6 months				
Injection only	0.67 (0.19-2.42)	**0.16 (0.03-0.99)**	1.53 (0.57-4.06)	0.55 (0.15-2.05)
Non-injection only	0.49 (0.18-1.34)	0.76 (0.13-4.43)	1.59 (0.76-3.30)	2.73 (0.56-13.27)
Both injection and non-injection	0.67 (0.19-2.42)	0.97 (0.25-3.70)	1.53 (0.57-4.06)	2.69 (0.84-8.62)
Alcohol	0.85 (0.43-1.65)		1.07 (0.60-1.91)	
Cigarettes	0.61 (0.28-1.31)		2.04 (0.96-4.32)	

Table 3.5 Association between class membership on healthcare utilization and health events⌘ relative to *Low* Multimorbidity class, n=604 ALIVE participants from 2014-2018

	Healthcare Utilization						Health Events			
	Medication for opioid use disorder§		Outpatient visit		Emergency room visit		Cardiovascular¥		Infectious*	
	OR (95% CI)	aOR⌘ (95% CI)	OR (95% CI)	aOR⌘ (95% CI)	OR (95% CI)	aOR⌘ (95% CI)	OR (95% CI)	aOR⌘ (95% CI)	OR (95% CI)	aOR⌘ (95% CI)
Multimorbidity	1.02 (0.66-1.58)	1.09 (0.68-1.74)	**2.52 (1.51-2.40)**	**2.00 (1.15-3.49)**	1.34 (0.78-2.30)	1.24 (0.71-2.19)	1.35 (0.89-2.06)	1.19 (0.76-1.86)	1.55 (0.98-2.44)	1.44 (0.89-2.34)
Multimorbidity with Psychiatric comorbidity	**2.39 (1.59-3.58)**	**1.97 (1.25-3.09)**	**2.09 (1.32-3.30)**	**1.76 (1.04-2.98)**	**1.96 (1.20-3.22**	**1.77 (1.03-3.02)**	1.13 (0.76-1.68)	1.03 (0.67-1.59)	**1.88 (1.21-2.91)**	1.56 (0.97-2.52)

⌘ Controlling for baseline age, sex, race, income, disability, insurance, same provider>90% of visits, and substance use

§ Medication for Opioid Use Disorder (MOUD) includes prescription of buprenorphine, naltrexone, or methadone in the last 6 months of the participant's last visit in 2018

¥ Cardiovascular events include self-report myocardial infraction, heart failure, heart disease, or stroke between 2014-2018

* Infectious events include self-report sepsis, pneumonia, endocarditis, or skin infection between 2014-2018

CHAPTER 4: Understanding Healthcare Engagement Among An Older Population of People Who Inject Drugs.

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Key Words: Multimorbidity, qualitative interviews, medication for opioid use disorder, healthcare utilization

Abstract

Background: People who inject drugs (PWID) have increased risk of morbidity and mortality related to their substance use and an increased burden of multimorbid chronic diseases. It is necessary thorough the experiences of this population to understand how management of multimorbid diseases, decisions to initiate treatment for substance use, and structural factors coalesce into healthcare engagement. The purpose of this study is to explore how this population engages in healthcare across three distinct classes of multimorbid burden.

Methods: This study is the qualitative aim 2 of an explanatory sequential mixed methods study. Quantitative findings from aim 1 identified three distinct classes of multimorbidity. Purposive sampling was conducted from each multimorbid class for semi-structured interviews to understand implications of engagement in care within and between classes. Qualitative descriptive method was applied for thematic analysis using the Behavioral Model for Vulnerable Populations as a conceptual framework.

Results: Participants in all three multimorbidity classes reported general adequacy of their current health insurance plans with some gaps in coverage described. Degree of multimorbidity impacted how individuals conceptualized being healthy with respect to their healthcare needs and whether perceived and actual needs aligned. Participants in each class listed different motivations and sources of information for managing their chronic diseases, with two classes listing the need to manage their mental health or active substance use before they could manage other multimorbid diseases. Finally, while specific advice given by participants for cessation of substance use differed by each class, participants across all three consistently listed that providers could not provide services for cessation to patients, “until they were ready.”

Discussion: Participants in this study highlighted multiple avenues for healthcare engagement. Policy considerations include low barrier access to public insurance, legislation that provides funding for clinics to provide wrap-around services to individuals with substance use disorder and removing MOUD prescription barriers. This study affirms the importance of healthcare integration and meeting the needs of this population at the level they are able to accept care.

Introduction

People who inject drugs (PWID) have increased risk of morbidity and mortality related to their substance use, including increased risk of overdose, Hepatitis C, and HIV (Bruneau, Roy, Arruda, Zang, & Jutras-Aswad, 2012; Martins, Sampson, Cerda, & Galea, 2015; Puzhko et al., 2017; Zibbell et al., 2018). Additionally, PWID continue to age and have an increased burden of multimorbid chronic diseases. The AIDS Linked Intravenous Experience (ALIVE) study, a Baltimore based longitudinal cohort of current and former PWID, previously identified high prevalence of multimorbid chronic conditions (Salter, Lau, Go, Mehta, & Kirk, 2011). Engagement in healthcare is essential for people who inject drugs (PWID) to receive harm reduction, medication for opioid use disorder (MOUD), and to address multimorbid chronic conditions to prevent excess morbidity and mortality (National Prevention Council, 2011; Office of National Drug Policy, 2010).

According to the Center for Advancing Health, engagement in healthcare is defined as, "actions individuals must take to obtain the greatest benefit from the healthcare services available to them" (Gruman et al., 2010). Data from Hepatitis C and HIV studies indicate that PWID engage in care at low rates, are less likely to access HCV and HIV testing, are often seen in later stages of disease, and face social and structural barriers (Artenie et al., 2015; Larney et al., 2017; Okeke, Ostermann, & Thielman, 2015; Oramasionwu, Moore, & Toliver, 2014; Thompson, Mugavero, Amico, & Cargill, 2018). Among PWID, younger age, incarceration, homelessness, lack of health insurance, poor provider continuity, and active substance use are predictors of poor engagement (Hartzler et al., 2018; Westergaard, Hess, Astemborski, Mehta, & Kirk, 2013; Westergaard, Kirk, Richesson, Galai, & Mehta, 2011). Understanding the complex nature of healthcare engagement for PWID is essential as prior work has shown engagement to

be limited, and this lower engagement is associated with poor health outcomes (Gryczynski, Mitchell, Peterson, Gonzales, & Schwartz, 2012; Madras et al., 2010)

PWID have poor prognosis related to substance use treatment and recovery as well as control of their multimorbid chronic diseases (Go et al., 2014; Joseph et al., 2016; Lazarus et al., 2016). This highlights the need for further research to examine engagement in healthcare for both substance use and other multimorbid chronic disease treatment and management. Addressing substance use as another multimorbid chronic disease facilitates delivery of high quality care to this vulnerable population. Given the lack of evidence regarding holistic healthcare engagement for PWID, it is necessary thorough the experiences of this population to understand how management of multimorbid diseases, decisions to initiate treatment for substance use, and structural factors coalesce into healthcare engagement.

Figure 1 describes the Behavioral Model for Vulnerable Populations (BMVP) is to examine healthcare engagement. From the model, Predisposing, Enabling, Need, and Health Behavior factors influence healthcare utilization and engagement (Andersen, 1968; Gelberg, Andersen, & Leake, 2000). Predisposing factors are individual characteristics such as age, gender, and relationship status, sexual orientation, and substance use (Gelberg et al., 2000). Enabling characteristics are organizational and financing factors such as health insurance status, health service resources, and region of residence (Gelberg et al., 2000). Need characteristics refer to those that are both perceived by an individual and those evaluated by healthcare providers (Gelberg et al., 2000). Health Behaviors are actions taken by individuals for management of their multimorbid diseases and substance use (Gelberg et al., 2000). This framework is useful to study healthcare engagement among people who inject drugs, because it provides a framework to understand characteristics associated with engagement in care salient to PWID.

The following is the second aim of an explanatory sequential mixed methods study nested within the ongoing ALIVE cohort. The purpose of this study is to explore how this population engages in healthcare across three distinct classes of multimorbidity. This study adds information for care engagement for this older population of PWID and the role healthcare environments play in their drug use or recovery. Qualitative findings from the qualitative aim are the focus of this report.

Methods

Parent Study

The AIDS Linked Intravenous Experience (ALIVE) study is a Baltimore, MD based community cohort of current and former people who inject drugs (PWID). Study methods have been published elsewhere (Vlahov et al., 1991). In brief, eligible participants were first recruited when the cohort was established in 1988 or during one of the subsequent recruitment waves during 1994-1995, 1999, 2005-2008, and 2015-2018. Eligibility criteria included being 18 years or older and injection drug use in the previous 6 months. Participants underwent biannual visits with an interview, clinical examination, and biospecimen collection. All participants provided written informed consent prior to participation in ALIVE.

Aim 1 and Sampling:

The present qualitative study is part of a sequential mixed methods study with the following research question: What are the healthcare needs of an aging population who inject drugs and how do they engage in their healthcare? Quantitative analysis from aim 1 of this study identified three unique classes of multimorbidity present within this population, based on the degree of disease probabilities present in each class. *Low Multimorbidity* (n=163, 27%) was the smallest class, with low probabilities of all eight diseases compared to the other two classes,

though there was still a high probability of hypertension (67%). The *Multimorbidity* class (n=190, 31%) had the highest probabilities on 6 of the 8 diseases studied. Finally, the *Multimorbidity with Psychiatric Comorbidity* class (n=251, 42%) had high probabilities of all diseases studied and the highest probabilities for the mental health disease indicators (Bipolar/Schizophrenia and Anxiety/Depression). A maximum variation, purposive sample for qualitative interviews was conducted with representation from each of the three multimorbidity classes to allow us to explore similarities, differences, and process of healthcare experience and engagement within and between classes (Palinkas et al., 2015; Sandelowski, 2000)

Study procedures:

24 semi-structured qualitative interviews with ALIVE participants were conducted during their regularly scheduled study visit occurring between June 2019-September 2019. Interviews lasted between 20 to 60 minutes. Participants were eligible for inclusion if their data were included in the quantitative arm and were sampled for representation within each of the 3 identified classes until saturation occurred. Saturation was reached at interview 20, with an additional 4 interviews conducted for better distribution of participants in each class. In-depth interviews were conducted to explore experiences and process with healthcare utilization and engagement including those previously described within the Behavioral Model for Vulnerable Populations, findings from quantitative analysis. At the end of the interview participants received $20 for their time. All participants provided oral informed consent and all agreed to audio recording of the interview. The Johns Hopkins Bloomberg School of Public Health Institutional Review Board approved study procedures. The consolidated criteria for reporting qualitative research (COREQ) was utilized to maximize quality and trustworthiness (Tong, Sainsbury, & Craig, 2007).

Qualitative Data Analysis:

Interviews were audio recorded and transcribed by an IRB approved transcription service, following data storage and handling procedures prescribed by the IRB. Using the BMVP as a guiding framework, a qualitative description methodology was applied, focusing on participant's perspectives with the phenomena of interest, healthcare engagement, (Bradshaw, Atkinson, & Doody, 2017). OH developed the initial codebook with *a priori* codes based on the BMVP (Gelberg et al., 2000; Miles & Huberman, 1994). The study team then met to listen to multiple interviews, revise *a priori* codes and conduct *in vivo* coding (Miles & Huberman, 1994). The domains utilized from the BMVP model for our study were: Enabling, Needs, and Health Behavior characteristics. Enabling characteristics included health insurance, income, and nonfinancial enablers including regular source of care, receipt of public benefits, and competing needs. Need characteristics encompassed a combination of participant perceived health needs and diagnosed diseases (actual need). Finally, Health Behaviors, actions taken and resources utilized by participants to control their chronic multimorbid diseases, were separately coded for those applying to chronic diseases (including mental health disorders) and those related to substance use.

Coding was conducted in Atlas.ti version 8.4. The research team independently coded multiple transcripts. Inconsistencies in coding were reviewed with revisions to the codebook until sufficient inter-coder agreement was reached (Krippendorf's alpha=0.78). Thematic analysis was conducted as codes were examined within each class, exploring and expanding major domain from the BVMP Model. Themes were considered as related responses with similar meaning and novel responses that were associated with the interview question (Denzin & Lincoln, 2011; Ryan & Bernard, 2003). Themes were also related participant responses that

provided novel understanding of their engagement in healthcare (Miles & Huberman, 1994; Saldana, 2009). Data presented in this study are themes related to healthcare utilization and engagement for an older cohort of current and former PWID, stratified by their membership within their multimorbidity class. Themes not directly related to the research question of this study, including those regarding safe injection/safe consumption spaces, are not included.

Results

A total of 24 participants were recruited across all three multimorbidity classes: *Low Multimorbidity* (n=9), *Multimorbidity* (n=5), and *Multimorbidity with Psychiatric Comorbidity* (n=10). Table 1 presents a list of participant characteristics, with no significant differences noted between classes. The majority of the study population was Black (83%) and male (62.5%). The median age of participants was 58 years old (range: 35-74) with similar median and range in all three multimorbidity classes. Slightly more than half the participants reported high school education (52%). A majority of participants reported an bi-annual income of less than $5,000; 67% reported receipt of disability services (Supplemental Security Income or Social Security Disability Income). All but one participant reported health insurance. Finally, 9 participants (37.5%) reported injection drug use in the previous six months.

Thematic Findings

Thematic finding are presented within the following domains from the BMVP: Enabling, Need, and Health Behavior (health behavior is separated by those that apply to chronic disease and those related to substance use). Themes that emerged within each domain below include both *a priori* from the BMVP and those that emerged *in vivo* from the open-ended questions. The theme origins are designated within the table.

Enabling

Three themes are described from the data: Financial coverage, Patient-provider relationship, and Service integration. Financial coverage and Patient-provider relationship were conceptualized *a priori* as salient to the enabling domain from the BMVP. The Service integration theme emerged *in vivo* and had the most relevance to this domain. Table 2 presents Enabling findings across classes of multimorbidity.

Financial coverage. Across all three classes no financial barriers to care reported. All participants reported health insurance coverage or an ability to pay for their care, including prescription coverage. In the *Multimorbidity with Psychiatric Comorbidity* class, the majority described a clinic service that reduced out of pocket costs for healthcare or linked them to health insurance. One participant described the clinic services, *"I've got an insurance card. I've got a counselor so…if something's wrong or anything, just let her know and she'll take care of it*" (ID024). While not specifically described as a barrier to overall healthcare engagement, at least one participant in each class reported gaps in coverage for dental and vision care, which could not be addressed with their current insurance plans.

Patient-provider relationship. Participants across the three classes described being satisfied and engaged in their healthcare when they viewed the relationship with their provider positively, including communication and continuity. Additionally, a majority of participants in the *Low Multimorbidity* class described positive experiences with provider. These positive experiences were often linked to an aspect of their care (i.e. the PCP also prescribed medication for opioid use disorder [MOUD] or treatment for HCV treatment), which facilitated their engagement. However, a third of the participants, reported some perceptions of stigma from providers compounded by competing financial priorities that influenced their decision to not engage in their healthcare and described a preference for ED or urgent care. Two additional

participant listed negative experiences of stigma, but their solution was to change healthcare providers. Participants in the *Multimorbidity with Psychiatric Comorbidity* class described returning for appointments and engagement with providers, for which, they described a 'friendship-like' quality to the relationship. Many who described positive patient-provider relationships also had long-term continuity with a provider with whom they build a strong rapport and their communication was established:

> "But to me it's more like a friend because she probes until she can find out what's going on with you and try to help you because people have crisis and just by looking you can't tell what's going on with a person, sometimes you have to dig a little deeper" ID014

Service integration. Participants described the benefits of integrated care services on care engagement, but at differing frequency and quality in each class. Only three participants in the *Low Multimorbidity* class reported integrated care services. Two were pleased that their PCP also prescribed their MOUD; another was satisfied with the ability to see a mental health provider and therapist at the same location as their medical care. All participants in the *Multimorbidity* class reported engagement with a primary care provider only, or having to go to multiple locations due to specialty care referrals. One patient, in particular, experienced fragmented care and challenging pain management in a situation where both their primary and specialty care providers no longer wanted to prescribe opioids for chronic pain management, a service which was previously integrated in their primary care management:

> "I've been taking pain medicine for the last 20 years….they have been treating me for chronic pain. And for the last year and a half, ever since the fentanyl breakout in the city, they have gotten real fearful with treating people that have chronic pain with narcotics. And they no longer does that. And I was referred to pain management, and the majority of the pain management clinics that I had went to wanted to treat my pain with the [suboxone]. Those are medicines that I had never heard of before, never tried them before. So I opted not to take it. So because I opted not to take it,

> they wouldn't treat me. So I'm in the process of trying to find someone to treat my pain management." ID005

Participants in the *Multimorbidity with Psychiatric Comorbidity* class described overall satisfaction when mental health and primary care were integrated in the same facility or managed by the same provider. Additionally, being at the same facility was perceived positively by those accessing MOUD. Communication between providers in an integrated center was particularly important. As one participant complained: "When I come out of there [ED] after 3 days, the program don't know nothing about it…doctor's don't talk to each other, they're both prescribing medications, they will not talk to each other about the patient" ID016.

Need

Two themes are described from the Need domain: Health construct and Alignment of needs. While neither theme appears within the BMVP, they are derived of the definition of Need in the BMVP. Perceived health needs are those described but participant subjectively while actual needs are underlying disease states (i.e. diagnosed by a healthcare provider). Health construct was conceptualized *a priori* to describe participant's perceived need. The Alignment of needs theme emerged *in vivo* and allows understanding of the relationship between perceived and actual need as they relate to engagement in care. Table 3 presents Need findings across the three classes.

Health construct. Participants from the three classes described their conceptualizations of health and what it meant for their healthcare needs. Distinct patterns emerged from each class. Almost all of the participants in the *Low Multimorbidity* class described their health construct in tangible terms with a focus on lifestyle modifications and a focus on preventative health (exercise, eating well, sleep, not smoking). In stark contrast, almost all individuals in the

Multimorbidity class described their healthy construct in more extreme terms of living versus dying:

> "S2: It means staying alive or dying. You got two choices. You either live or you die. That's the only choices you got. The rest is just in-between.
>
> S1: Okay. Is there an in-between in staying alive? Is there an optimal way to live or a not so optimal?
>
> S2: You're here to live or to die. The rest, you are on your own. So you got to figure out which way you going here. You want to live, you go that way. You don't want to live, I guess you going that way" ID 007

Nearly all participants experiencing *Multimorbidity with Psychiatric Comorbidity* described more tangible health constructs, listing specific behaviors of disease management. This was particularly true concerning mental health discussions: "Being healthy means being conscious, updated, and mindful of the things that's going on with me through the things that I do to me; and seeking help in an ample amount of time" ID016. A few participants in this class described their health as being rooted in a desire to live informed by their past traumas, with one participant describing being healthy as, "…taking care of yourself, being in a safe environment, taking care of your body, your mind, your soul, your whole physical being…my psychiatrist, dealing with my depression, my family, support, and I have financial assistance, a stable place to live, things like that." ID019.

Alignment of Needs. Engagement in and satisfaction with care was higher for those participants who had an alignment of their self-perceived and actual needs (those diagnosed by the provider). This theme was unique to the *Multimorbidity with Psychiatric Comorbidity* class alone, as participants who were satisfied with their healthcare described their perceived health needs met by providers, as well as providers working with them to better align perceived and actual needs with resources and education:

> "When I first came there…told me that they didn't know what to do with me because I was so angry. I was a very angry person…. And I was trying to-- they were trying to put me on the right medication that would stabilize me because I was just everywhere at that time. And it took them about five years to get me on the right medication…the people there, they were hands on. They seen that I needed a little extra help. And they just love me. I mean, I have a great personality. Deep down inside, I do have a temper. But I help people out. They help me out." ID021

Health Behaviors- Chronic Disease

Two themes are described from this domain: Advice and resources, and Social networks. Advice and resources was conceptualized *a priori* as a theme relating to the health behaviors participants found salient to their care engagement. Social networks as it related to participant's health behaviors for chronic disease management emerged a theme within this domain. Table 4 presents Chronic Disease Health Behavior findings.

Advice and Resources- Chronic Disease. This theme captured the advice given by participants to healthcare providers or resources utilized by participants from their care team that allowed them to better control their chronic diseases and engage in care. Participants in the *Low Multimorbidity* class discussed substance use cessation as a necessary step before chronic disease management. Many also listed the benefit of MOUD and other substance use services (therapy, group counseling, etc.) as important resources necessary before they could engage in care. In contrast, all but one of the *Multimorbidity* participants listed lifestyle modifications as the largest source of chronic disease management from their healthcare team. Nearly all *Multimorbidity with Psychiatric Comorbidity* participant described their care team as central to keeping them engaged in care by being a source for services, information, care coordination, and encouragement. However, they presented this could only occur when the participant was ready to engage in their care:

> "They keep me going anything-- anything I have. I be asking questions... And they had helped me for years but I've been with them for a long time… Well, one thing is up to the person. If they're willing to keep their health or want to. And understand what they're going to do with their life. There's people out there, man, that's healthy and everything and some don't care" ID011

Social Networks. Participants in the *Low Multimorbidity* and *Multimorbidity with Psychiatric Comorbidity* classes described how their social networks acted as barriers and facilitators to chronic disease management. Participants in the *Low Multimorbidity* class reviewed how some aspects of social networks and environment acted as facilitators to disease management while others could act as barriers to long term SUD recovery and compete with their health needs:

> "Just change of environment really, that's the basics right there. And my family helps out a lot. We do a lot of things together, talk, and social…For me it was environment because I'm from the streets pretty much and just to maintain what I have now I have to stay away from that atmosphere and I try. I still have some friends that are-- but, like I said, I try to for the most part stay away from them." ID023

Multimorbidity with Psychiatric Comorbidity participants distinctly described their social networks as a source of knowledge and experience for managing chronic diseases as well as a source of strength through their care journey, exemplified by, "That's why I talk to certain people, what they going through, and I tell them what I'm going through… we'll be sharing information for us or what to do, or what type of help to get to help each other and whatnot" ID002.

Health Behaviors- Substance Use

Two themes are described from this domain: *Advice and resources*, and *Sustained recovery*. *Sustained recovery* was an *a priori* theme as it provided insight behaviors for management of substance use disorder. Advice and resources was also conceptualized *a priori* as

a theme relating to what participants found salient to their care engagement with respect to their current or recovery from substance use. Table 5 presents Substance Use Health Behavior findings in the three multimorbidity classes.

Sustained Recovery. Participants across the three classes discussed differential patterns of treatment sought for sustained recovery from substance use. The *Multimorbidity* class was distinct as participants discussed quitting substance use without the use of MOUD. Some even expressed some negative impressions regarding MOUD use:

> I know people that's been on the methadone program for 30 years. 30 years! They need to have some kind of cutoff. …I didn't take no methadone. I didn't go in no detox. I just got tired of being tired. I just told myself, "Okay. You'll be sick for a few days. It's better for you to be sick for two, or three, or four days than you having to go [out wait here?] for months and years and years and wondering, do whatever to try to get the drug." ID005

In contrast, half of the *Low Multimorbidity* class and nearly all with *Multimorbidity with Psychiatric Comorbidity* described either MOUD or treatment for mental health comorbidities as a means for stability that allowed them to reduce their substance use:

> When I first came there… they were trying to put me on the right medication that would stabilize me because I was just everywhere at that time. And it took them about five years to get me on the right medication. The PRP program, and the people there, they were hands on. They seen that I needed a little extra help. And they just love me. I mean, I have a great personality. Deep down inside, I do have a temper. But I help people out. They help me out. Do class work together." ID021

Advice and Resources- Substance Use. This theme concerned advice to healthcare providers or resources utilized by participants that allowed them to better control their substance use and engage in care. The vast majority of participants across the three classes stated that providers could not help their patients with substance use cessation, "until they were ready." The

participants, however, emphasized the importance for providers to remain an open source of care, even for patients with active use or relapse. All participants, but particularly those in the *Low Multimorbidity* and *Multimorbidity with Psychiatric Comorbidity* classes, advised care teams to meet participants where they are in their recovery, emphasizing that providers should provide a positive and accepting presence at care opportunities:

> "Just talk to them. And if you got an individual that has taken to you, listening to you, keep going to that person. That person might finally change like I did… Because everybody has a soul. Everybody has a heart. And like I said, show them that you have a heart, put down, don't be scared to help them. Don't be scared to stand to talk to them. Don't be scared to drink a cup of coffee with them or something." ID006
>
> "Listen to them. Just listen. And just encourage them. They can get better. Because a lot of people don't do that. They just, "Well, you're using, and you want to go kill yourself, just go kill yourself." But if they got somebody that's positive in their corner, it's a big difference." ID025

One participant advised providers to learn as much as possible about their patient's substance use and personal triggers as a mitigating strategy and to offer counseling for sustained recovery. Additionally, participants in the *Multimorbidity* class most consistently advised the use of incentives as a means to encourage recovery. One participant suggested, "Like if they do come meet all the appointments, they give them like $25. If they meet all they appointments. And the second is for people that don't come, they give them like $125 so they can come" ID020.

Discussion

This study explored healthcare needs and engagement for an aging population of current and former people who inject drugs from three distinct classes of multimorbidity. Our findings suggest that the healthcare needs and engagement in care are unique within each multimorbid class, with some areas of overlap. Multiple themes emerged from each domain, some of which were novel or otherwise unexpected based on what was already known in this area. First, the lack

of financial barriers described by participants with respect to healthcare costs and insurance stood out for this mostly low-income and vulnerable population. The alignment of participant's healthcare needs emerged as a theme with particular relevance to overall engagement in care and highlighted one of the limitations of using the BMVP as a conceptual framework. Social networks emerged from participants describing their ability to manage their chronic diseases due to their social network, discussed within the context of the health behavior theme rather than one in the enabling domain. Finally, within the *a priori* theme of Advice and resources for the Health behaviors-Substance use domain, each multimorbidity class provided important contextualization for how they experience healthcare systems, suggesting implications for future research and clinic practice given their underlying comorbidities. Specific implications for each theme are described below. Consistent with our *a priori* themes, participants in each class listed different motivations and sources of information for managing their chronic diseases, with two classes listing the need to manage their mental health or active substance use before they could manage other multimorbid diseases. While specific advice given by participants for cessation of substance use differed by each class, participants across all three consistently listed that providers could not provide services for cessation to patients, "until they were ready."

From the enabling domain, access to and coverage by health insurance was listed as a facilitator across all three classes. Many studies have confirmed this finding, demonstrating a positive association between health insurance and health engagement (Barocas et al., 2014; Hoots, Finlayson, Broz, & Paz-Bailey, 2017; Knowlton et al., 2010; Riley et al., 2002; Wilkinson et al., 2007). This evidence could indicate that provisions that expand healthcare services, particularly the ACA that expanded Medicaid in states like Maryland, where this study was conducted, are particularly important to maintaining security with respect to health insurance.

Participants in the three classes did list gaps in dental and vision coverage, areas currently not covered by public insurance but could be targeted for future legislation that expands healthcare.

Participants listed their patient-provider relationship as an important factor in their healthcare engagement, consistent with existing literature (Barocas et al., 2014; Biello et al., 2018; Knowlton et al., 2010; Skeer, Ladin, Wilkins, Landy, & Stopka, 2018). Having a friendship like quality to their relationship, potentially indicative of long-term care continuity with a provider, was particularly important to the multimorbidity class with the highest probability of mental health disorders. Participants in the *Low Multimorbidity* class reported a positive patient-provider relationship when care was integrated with one provider. The participants in *Multimorbidity with Psychiatric Comorbidity* echoed a similar sentiment, with particular focus on the desirability of accessing their primary care and mental health services in the same location. Co-location of services for this population has received increased national attention from policy makers, with a report from the Surgeon General listing the growing impetus from integrated care services for this population as a key area for health centers to increase capacity (US Department of Health and Human Services [DHHS], 2016).

Participant's experiences from these interviews provided novel insight into their conceptualization of health as a construct with respect to their healthcare needs, the degree to which these perceived needs aligned with their actual needs, and the context of this for engagement in care. The findings across the three classes indicated that those with closer alignment of their perceived and actual needs had greater engagement in care. The health constructs were also reflective of the degree of multimorbidity present in the class. The *Low Multimorbidity* class listed their health constructs and needs with respect to preventative health behaviors (i.e. quitting smoking, losing weight, etc.) while the *Multimorbidity with Psychiatric*

Comorbidity class described specific provisions in their health construct and needs with respect to mental health care. Based on participant descriptions, the Health Belief Model may offer better constructs to understand these findings. Participants in the *Low Multimorbidity* class had lower level of perceived susceptibility and severity of health problems in contrast to those in the *Multimorbidity with Psychiatric Comorbidity* class. This later class also had high perceived susceptibility and severity of disease, particularly with respect to their mental health, while also influenced by perceived benefits of seeing their providers and taking actions for their health management (Becker, 1974; Champion & Skinner, 2008). Future studies with this population may benefit from an adaptation of the BMVP to include provisions from the health belief model to better understand specific constructs in the Needs domain, such factors of perceived susceptibility and severity of disease, perceived benefits of care, and health motivation (Becker, 1974; Champion & Skinner, 2008).

Health behaviors to manage chronic diseases varied across classes and were likely a function of the multimorbidity class. Participants in their *Multimorbidity with Psychiatric Comorbidity* class in particular listed their care team and wrap around services as useful for their healthcare engagement, particularly for their mental health. These participants later also listed the need to stabilize their mental health as a provision for cessation from substance use and injection., Multiple studies have shown that substance use and mental health disorders are highly correlated (Kelly & Daley, 2013; Klinkenberg & Sacks, 2004; Ross & Peselow, 2012). While no study could be located to confirm our findings of a participant descriptions of stabilizing mental health as a means for substance use cessation, some studies identified an unmet treatment need for individuals with triple diagnosis of substance use disorder, mental health disorder, and chronic disease. There is also some evidence demonstrating an improvement of chronic disease

management following treatment for mental health disorder (Klinkenberg & Sacks, 2004; Tegger et al., 2008). Wrap-around services provide linkage to services including disability, housing, and social worker support. (Kay & Westfall, 2020). These services, however, are not often available at all clinic facilities and are often limited when available. The Comprehensive Addiction Resources Emergency (CARE) Act provides funding to health centers and systems for hiring clinicians and ancillary healthcare workers to provide these wrap-around services and improve engagement in care, particularly for the vulnerable subset of individuals with co-occurring mental health disorders (H.R.2569, 2019). Legislation of this nature expands much needed services that are often underfunded but were highlighted by study participants as necessary resources utilized for healthcare engagement.

Participants across the three classes listed their social networks as both barriers and facilitators to healthcare engagement. In particular, participants in all classes generally listed that their social networks could be a source of information to control their chronic disease but could also pose barriers to substance use recovery and management of their mental health. Previous studies have confirmed the role of social networks as both barriers and facilitators to care management (Biello et al., 2018; Broadhead et al., 2002; Latkin et al., 2008). Clinicians should view individual's social networks as a key area for assessment and intervention, leveraging positive interactions as a means for ongoing engagement while counseling their patients to be mindful and providing support to avoid social networks that are deleterious to their health and care outcomes. Additionally, peer groups and counseling could be a means to achieve the benefits of healthcare engagement while also providing insights and resources to more effectively manage social networks that present barriers to long term recovery and care (Broadhead et al., 2002; Latkin et al., 2008).

The use of medication for opioid use disorder varied across class, with participants in the *Multimorbidity* class listing non-medication strategies for recovery and even expressing some stigma against those who required medications. While not directly reported by participants, their language mirrored some language from 12-step programs, where there has been a persistent cultural stigma against those who utilize MOUD. Despite this, there is robust evidence of the benefits of MOUD, confirmed by participants in the *Low Multimorbidity* and *Multimorbidity with Psychiatric Comorbidity class* (Islam et al., 2013; Mehta et al., 2015; Miller et al., 2018; Morozova, Dvoriak, Pykalo, & Altice, 2017; Parmenter et al., 2013; Wang et al., 2013). Primary and integrated care facilities should provide MOUD for individuals with current or recovering substance use (DHHS, 2016). Additionally, there is evidence that peer based support groups, similar to 12 step programs, can play a role in long term recovery when they provide a holistic and non-stigmatized environment for participants (Krawczyk, Negron, Nieto, Agus, & Fingerhood, 2018). Finally, lack of providers with licenses to prescribe MOUD or limitations to the number of patients for whom they can prescribe has been shown to be a barrier to MOUD access for this population (Marino et al., 2019). Given participant's clear indication of MOUD as a provision for healthcare engagement, future legislation should remove barriers that healthcare providers face and allow for a seamless transition into integrated care.

There are limitations to consider. The study population is from an aging cohort in an urban setting with demographics that are not representative of the general substance using population. Additionally, the study presented here is the qualitative aim from a larger explanatory sequential mixed methods study. Participants were only eligible if they met inclusion criteria for the quantitative aim, limiting to participants surviving for data collection between 2014-2018 and with a high number of study visit. Given time constraints and difficulty

with recruitment, member checking of the analysis presented here was not done. Additionally, while there was similar distribution for two classes, the number of participants in the *Multimorbidity* class was low (n=5). However, there were 24 interviews conducted in total, with thematic analysis consistent across all three classes for many themes. Finally, participants were only able to be interviewed once, with some qualitative methodologists suggesting multiple interviews to improve trustworthiness of data (Murray et al., 2009; Polkinghorne, 2005). Overall, our participants were able to relate experiences with healthcare, sampling from classes of multimorbidity, allowing us to obtain a holistic understanding of how this aging population engages in their healthcare for their complex needs.

Future studies with this population should be conducted with an adapted framework of the BMVP with the Health Belief Model to better understand the healthcare needs of individuals with SUD. Better understanding of participant's perceptions for optimal healthcare engagement can provide additional avenues for interventions and leverage strengths for sustained healthcare. Participants in this study highlighted multiple avenues for healthcare engagement, including positive patient-provider relationship, sustained health insurance, alignment of their healthcare needs with those designated by healthcare providers, and receipt of integrated care that can address pressing health needs. Policy considerations include the continued provision of low barrier access to public available insurance, passage of legislation that provides funding for clinics to provide wrap-around services to individuals with substance use disorder and removing MOUD prescription barriers. Finally, this study affirms the importance of healthcare integration in addition to meeting the needs of this population at the level they are able to accept care.

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Table 4.1 Study sample baseline, 24 ALIVE participants from 3 Multimorbidity classes			
	Class 1: Low Multimorbidity (n=9)	Class 2: Multimorbidity (n=5)	Class 3: Multimorbidity with Psychiatric Comorbidity (n=10)
Predisposing			
Age (mean, std. dev)	57 (4.4)	58 (6.1)	58 (10.4)
Female sex	2 (22%)	4 (80%)	3 (30%)
Race	8 (89%)	4 (80%)	8 (80%)
Enabling			
Insurance	7 (88%)	5 (100%)	10 (100%)
Income	4 (44%)	3 (60%)	6 (60%)
Disability	5 (56%)	3 (60%)	8 (80%)
Same provider last 2 years	5 (56%)	2 (40%)	6 (60%)
Health Behaviors (last 6 months)			
Any drug use*	4 (44%)	1 (20%)	6 (60%)
Injection drug use only	3 (33%)	0 (0%)	6 (60%)
Alcohol	3 (33%)	2 (40%)	5 (50%)
Cigarettes	7 (78%)	4 (80%)	7 (70%)
Healthcare Utilization (last 6 months)			
Emergency Room Visit	1 (11%)	2 (40%)	2 (20%)
Outpatient Clinic Visit	4 (44%)	4 (80%)	8 (80%)
Medication for Opioid Use Disorder	5 (56%)	2 (40%)	6 (60%)

Figure 4.1 Behavioral model for vulnerable populations

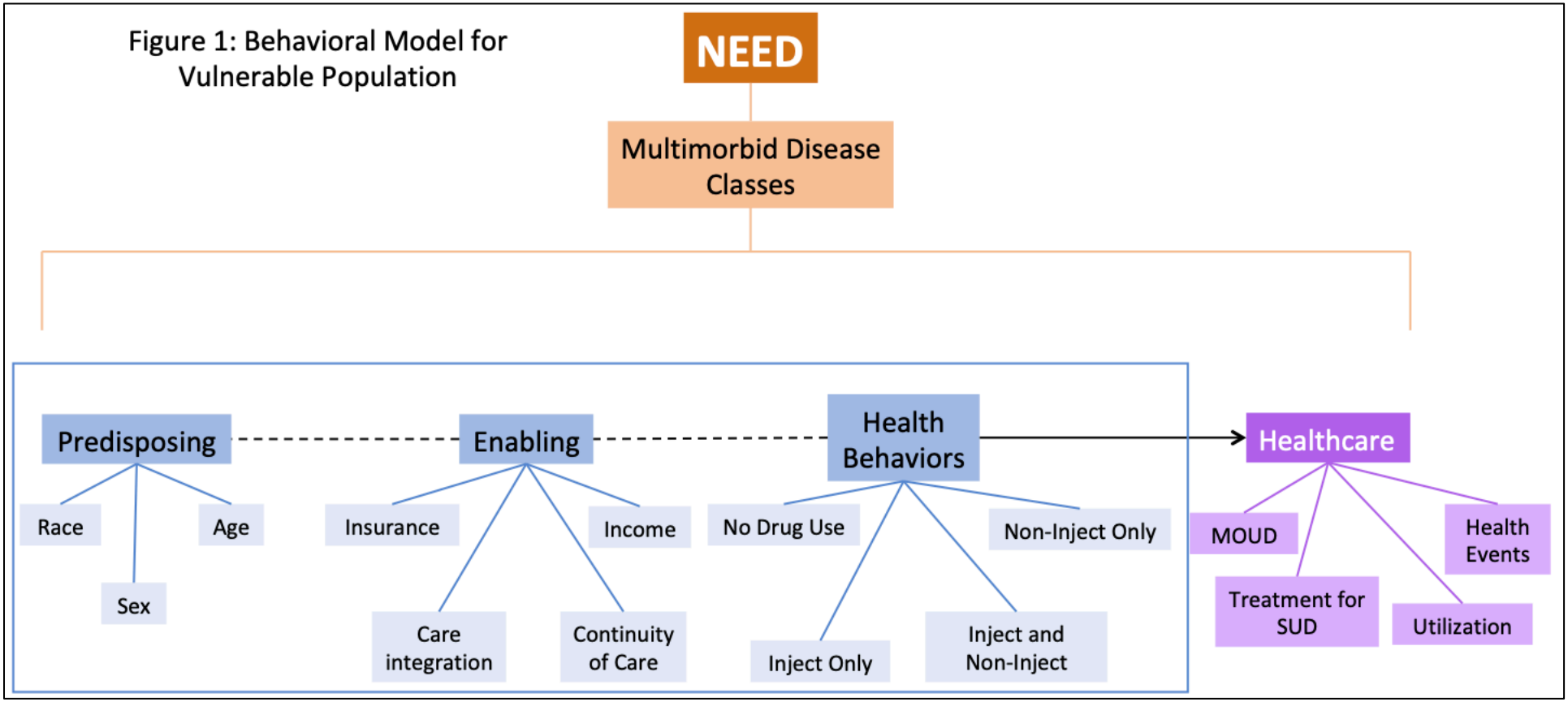

Table 4.2 Thematic analysis from the Enabling domain across three Multimorbidity classes				
Domain: ENABLING	**Multimorbidity Class**			
Subthemes	Class 1: Low Multimorbidity (n=9)	Class 2: Multimorbidity (n=5)	Class 3: Multimorbidity with Psychiatric Comorbidity (n=10)	Participant Quotes
Financial	Across all three classes no financial barriers to care reported. All participants reported health insurance coverage or an ability to pay for their care, including prescription coverage.			*"I've got an insurance card. I've got a counselor so…if something's wrong or anything, just let her know and she'll take care of it*" (ID024, Class 3).
Patient-provider relationship	Participants across the three classes described being satisfied and engaged in their healthcare when they viewed the relationship with their provider positively, including communication and continuity.			"But to me it's more like a friend because she probes until she can find out what's going on with you and try to help you because people have crises and just by looking you can't tell what's going on with a person, sometimes you have to dig a little deeper" (ID014, Class 2)
Service integration	A minority (n=3) of Class 1 participants reported integrated care services for MOUD or mental healthcare	All Class 2 participants reported engagement with a primary care provider or having to go to multiple locations due referrals	Class 3 participants described overall satisfaction when **mental health** and primary care were integrated in the same facility or managed by the same provider	

Table 4.3 Thematic analysis from the Enabling domain across three Multimorbidity classes				
Domain: NEED	Multimorbidity Class			
Subthemes	Class 1: Low Multimorbidity (n=9)	Class 2: Multimorbidity (n=5)	Class 3: Multimorbidity with Psychiatric Comorbidity (n=10)	Participant Quotes
Health construct	Almost all of the Class 1 participants described their health construct in tangible terms with a focus on lifestyle modifications and a focus on preventative health (exercise, eating well, sleep, not smoking)	Almost all Class 2 individuals described their healthy construct in more extreme terms of living or dying.	Nearly all Class 3 participants described more tangible health constructs, listing specific behaviors of disease management. This was particularly true concerning mental health discussions.	"It means staying alive or dying. You got two choices. You either live or you die. That's the only choices you got. The rest is just in-between…You're here to live or to die. The rest, you are on your own. So you got to figure out which way you going here. You want to live, you go that way. You don't want to live, I guess you going that way" ID 007, Class 2 "Being healthy means being conscious, updated, and mindful of the things that's going on with me through the things that I do to me; and seeking help in an ample amount of time" ID016, Class 3
Alignment of Needs			Class 3 participants who were satisfied with their healthcare described their perceived health needs met by providers, as well as providers working with them to better align perceived and actual needs with resources and education	"When I first came there…told me that they didn't know what to do with me because I was so angry. I was a very angry person…. And I was trying to-- they were trying to put me on the right medication that would stabilize me because I was just everywhere at that time. And it took them about five years to get me on the right medication…the people there, they were hands on. They seen that I needed a little extra help. And they just love me. I mean, I have a great personality. Deep down inside, I do have a temper. But I help people out. They help me out." ID021, Class 3

Table 4.4 Thematic analysis from the Health Behaviors- Chronic Disease domain across three Multimorbidity classes				
Domain: HEALTH BEHAVIORS- Chronic Disease	Multimorbidity Class			
Subthemes	Class 1: Low Multimorbidity (n=9)	Class 2: Multimorbidity (n=5)	Class 3: Multimorbidity with Psychiatric Comorbidity (n=10)	Participant Quotes
Advice and Resources	Class 1 discussed substance use cessation as a necessary step before chronic disease management. Many listed MOUD and other substance use services (therapy, group counseling, etc.) as important resources.	All but one of Class 2 participants listed lifestyle modifications as the largest source of chronic disease management from their healthcare team	Participants described their care team as central to keeping them engaged in care by being a source for services, information, care coordination, and encouragement	"They keep me going anything-- anything I have. I be asking questions... And they had helped me for years but I've been with them for a long time… Well, one thing is up to the person. If they're willing to keep their health or want to. And understand what they're going to do with their life. There's people out there, man, that's healthy and everything and some don't care" ID011, Class 3
Social Networks	Participants in Class 1 reviewed how some aspects of social networks and environment acted as facilitators to disease management while others could act as barriers to long term SUD recovery and compete with their health needs		Participants in Class 3 distinctly described their social networks as a source of knowledge and experience for managing chronic diseases as well as a source of strength through their care journey	"Just change of environment really, that's the basics right there. And my family helps out a lot. We do a lot of things together, talk, and social…For me it was environment because I'm from the streets pretty much and just to maintain what I have now I have to stay away from that atmosphere and I try. I still have some friends that are-- but, like I said, I try to for the most part stay away from them." ID023, Class 1 "That's why I talk to certain people, what they going through, and I tell them what I'm going through… we'll be sharing information for us or what to do, or what type of help to get to help each other and whatnot" ID002, Class 3

Table 4.5 Thematic analysis from the Health Behaviors- Substance Use domain across three Multimorbidity classes				
Domain: HEALTH BEHAVIORS- Substance Use	Multimorbidity Class			
Subthemes	Class 1: Low Multimorbidity (n=9)	Class 2: Multimorbidity (n=5)	Class 3: Multimorbidity with Psychiatric Comorbidity (n=10)	Participant Quotes
Advice and Resources	The vast majority of participants across the three classes stated that providers could not help their patients with substance use cessation, "until they were ready." The participants, however, emphasized the importance for providers to remain an open source of care, even for patients with active use or relapse			"Just talk to them. And if you got an individual that has taken to you, listening to you, keep going to that person. That person might finally change like I did… Because everybody has a soul. Everybody has a heart. And like I said, show them that you have a heart, put down, don't be scared to help them. Don't be scared to stand to talk to them. Don't be scared to drink a cup of coffee with them or something." ID006, Class 1
		Class 2 participants most consistently advised the use of incentives as a means to encourage recovery		
Sustained Recovery	Half the members described either MOUD as a means for stability that allowed them to reduce their substance use	Class 2 was distinct as participants discussed quitting substance use without the use of MOUD. Some even expressed some negative impressions regarding MOUD use.	Nearly all described either MOUD or treatment for mental health comorbidities as a means for stability that allowed them to reduce their substance use	I know people that's been on the methadone program for 30 years. 30 years! They need to have some kind of cutoff. …I didn't take no methadone. I didn't go in no detox. I just got tired of being tired. I just told myself, "Okay. You'll be sick for a few days. It's better for you to be sick for two, or three, or four days than you having to go [out wait here?] for months and years and years and wondering, do whatever to try to get the drug." ID005, Class 2 When I first came there… they were trying to put me on the right medication that would stabilize me because I was just everywhere at that time. And it took them about five years to get me on the right medication. The PRP program, and the people there, they were hands on. They seen that I needed a little extra help. And they just love me. I mean, I have a great personality. Deep down inside, I do have a temper. But I help people out. They help me out." ID021, Class 3

CHAPTER 5: Lessons learned from an explanatory sequential mixed methods study and implications for healthcare engagement for people who inject drugs.

The goal of this study was to understand the needs of people who inject drugs and how they engage in care. This is among the few studies to explore the holistic healthcare needs of this population as relative to management of multimorbid diseases, substance use, and long-term recovery. This chapter discusses the major findings from each study aim, the strengths and limitations of the data based papers, and implications of the findings. Additionally, suggestions for future research are discussed.

Summary of Findings

Taken together, the findings of this dissertation found complex healthcare needs for this population, described the role of those needs on healthcare engagement, and suggest directions for future research, interventions, and policies. Healthcare need was characterized as three distinct classes of multimorbidity found with latent class analysis, each with its own implications for healthcare utilization and engagement. Findings from quantitative and qualitative analysis showed health insurance status did not serve as a barrier to healthcare access, with almost ubiquitous coverage in this post-ACA era study. While continuity of care was not associated with any class of multimorbidity, interviews with participants highlighted that patient-provider relationship, strengthened by integrated care, were important provisions for healthcare engagement. Additionally, a subset of participants in qualitative interviews described having benefited from focused case management for wrap-around services, particularly those in the multimorbidity class co-occurring mental health disorder. Thematic analysis from this class also found the importance of mental health stability in order to support management of substance use or recovery, and other chronic diseases. Finally, quantitative and qualitative analysis showed

prescription of medication for opioid use disorder linked with certain multimorbid classes, highlighting it as an important provision for healthcare engagement. Specific findings from each study aim are listed below, followed by their implications, including an update to the BMVP to better conceptualize engagement in care for future studies.

The systematic review presented barriers and facilitators salient to healthcare engagement and utilization for PWID with active injecting, highlighting multiple areas. Factors of co-location of services, case management, active injection, and patient-provider relationship were associated with health utilization and engagement. The factors identified can be utilized by future interventions and studies to better integrate the care needs of this population holistically in one setting with the goal of reducing the morbidity and mortality associated with injection drug use.

Aim 2 identified three distinct classes of multimorbidity in an older cohort of current or former PWID. Nearly 75% of the sample fell into the classification of having *Multimorbidity* or *Multimorbidity with Psychiatric Comorbidity*. Individuals in each of these two groups had extremely high co-occurring probabilities of all of the diseases we considered with the key distinction of additional psychiatric comorbidity in one group. These groups were significantly more likely to receive disability, and had higher healthcare utilization, and, while not unexpected, had consequences for the healthcare system and these individuals.

Aim 3 explored engagement within an aging population of current and former people who inject drugs from three distinct classes of multimorbidity identified in Aim 2. We used the Behavioral Model for Vulnerable Populations to inform the field guide for semi-structured interviews and thematic analysis within and between the multimorbid classes. Our findings suggest that aspects of healthcare needs and engagement in care are unique in each multimorbid class, with some areas of overlap. Participants in all three classes almost entirely felt supported

with their current health insurance plans but listed some gaps in coverage. Degree of multimorbidity impacted how individuals conceptualized being healthy with respect to their healthcare needs and whether perceived and actual needs aligned. Participants in each class listed different motivations and sources of information for managing their chronic diseases, with two classes emphasizing the need to manage their mental health or active substance use before they could manage other multimorbid diseases. Finally, while specific advice given by participants for cessation of substance use differed by each class, participants across all three consistently listed that providers could not provide services for cessation to patients, "until they were ready."

Strengths and Limitations

There are limitations to within this explanatory sequential mixed methods study (aims 2, 3). From aim 2, while diseases are measured over a five-year period and most with a physiological or biological marker to confirm diagnosis, there were still some disease states that were classified by self-report alone. This is a particular limitation with severe psychiatric disorders, though classification was based on self-report of diagnosis or prescription of a medication. There was also overlap with measurement of diseases over the five-year period and the healthcare utilization and health event data, limiting the temporality of associations. However, this study's purpose was to determine the holistic needs of an aging population of PWID and not infer causality of multimorbidity class on outcomes. Our study's restriction to participants with study visits in 2014 and first visit in 2018 limited the sample size, though sensitivity analysis with all participants with a 2014 visit only indicate a similar 3 class structure of multimorbidity. Latent class analysis and finite mixture modeling can be useful tools of determining heterogeneity of multimorbidity but future studies should attempt to select diseases and classify their states based on an established criteria. One study utilized the Charlson

Comorbidity Index when selecting diseases and its measurement, a potential standard for future comorbidity studies (Islam et al., 2014). Additionally, HIV was evenly distributed in all three classes and was not associated with membership in any class with regressions. This indicates a need for future research to conduct a similar analysis but stratify by HIV status. Because this data was from an aging population of largely Black, male, and urban population, its findings are not generalizable to the larger population of people who inject drugs. Future studies should attempt to classify based on severity of disease states and utilize longitudinal data to determine transitions of multimorbid disease management.

There are additional limitations from aim 3. Participants were only eligible for aim 3 if they met inclusion criteria for the aim 2, limiting our description only to those surviving for data collection between 2014-2018 and with a high number of study visits. Additionally, while there was similar distribution for two classes, the number of participants in the *Multimorbidity* class was low (n=5). However, there were 24 interviews conducted in total, with thematic analysis consistent across all three classes for many themes. Finally, participants were only able to be interviewed once, with some qualitative methodologists suggesting multiple interviews to improve trustworthiness of data (Murray et al., 2009; Polkinghorne, 2005). The themes here though were confirmed with multiple participants perspectives and between multimorbidity classes, and representative of an urban substance using population. Overall, our participants were able to relate experiences with healthcare, sampling from classes of multimorbidity, allowing us to obtain a holistic understanding of how this aging population engages in their healthcare for their complex needs.

There are important study strengths which offset the limitations. First, the mixed-methods design supported an exploration of the complexity nature of healthcare need and engagement for

this older population. This approach allows for triangulation of methods to answer the complex research question (Creswell & Cresswell, 2018). Additionally, this is the first study to our knowledge to expand on the complex healthcare needs of this population, accounting for multimorbidity of chronic diseases and substance use disorder as important factors in individual's care trajectories. Aim 2 highlights nuanced patterns of multimorbidity for this population that moves beyond the number of diagnosed diseases as they relate to healthcare engagement. The exploration within and between classes of multimorbidity highlighted that healthcare needs for this population are not homogenous and are associated with utilization of healthcare services. Using these classes for purposive sampling provided novel insights into how this population engages in healthcare. This mixed-methods approach utilized finite mixture modeling as a means for describing healthcare need, served as the basis for sampling, and informed aim 3 data collection.

Implications

The findings from aim 2 and 3 highlighted areas of need and directions for engagement in care for people who inject drugs. Major implications of the findings from this study are presented in the domains from the Behavioral Model of Vulnerable Populations.

Enabling

Participants in latent classes with increased multimorbidity were significantly more likely to receive disability services (SSI/SSDI) compared to the *Low Multimorbidity* class. Additionally, the *Multimorbidity* class was significantly more like to have insurance compared to the *Low Multimorbidity* class in bivariate analysis. These findings were echoed during qualitative interviews, as participants in all three classes did not report financial barriers to care. Many studies have confirmed this, demonstrating a positive association between health insurance and

health engagement (Barocas et al., 2014; Hoots, Finlayson, Broz, & Paz-Bailey, 2017; Knowlton et al., 2010; Riley et al., 2002; Wilkinson et al., 2007). This evidence could indicate that provisions that expand healthcare services, particularly the ACA that expanded Medicaid in states like Maryland, where this study was conducted, are particularly important to maintaining security with respect to health insurance. Provisions to continue public healthcare insurance and receipt of disability services are vital to the subset of this population with increased multimorbidity.

While differences in continuity of care with the same healthcare provider were not found with the multimorbidity classes, there were suggestions that this was an important factor that was not completely captured by quantitative analysis. Participants listed their patient-provider relationship as an important factor in their healthcare engagement, consistent with existing literature (Barocas et al., 2014; Biello et al., 2018; Knowlton et al., 2010; Skeer, Ladin, Wilkins, Landy, & Stopka, 2018). Having a friendship-like quality to their relationship, potentially indicative of long-term care continuity with a provider, was particularly important to the multimorbidity class with the highest probability of mental health disorders. Participants in the *Low Multimorbidity* class reported a positive patient-provider relationship when care was integrated with one provider. The participants in *Multimorbidity with Psychiatric Comorbidity* echoed a similar sentiment, with particular focus on the desirability of accessing their primary care and mental health services in the same location. Co-location of services for this population has received increased national attention from policy makers, with a report from the Surgeon General listing the growing impetus for integrated care services for this population (US Department of Health and Human Services [DHHS], 2016).

Need

Aim 2's analysis with LCA demonstrated a significant burden of multimorbid chronic diseases. Multiple studies have examined classes of multimorbidity in the general aging population using latent class analysis (Gellert et al., 2019; Hall et al., 2018; Hustoft et al., 2013; Islam et al., 2014; Olaya et al., 2017; Park, Lee, & Park, 2019; Whitson et al., 2016). While those studies and this differ in their selection and measurement of diseases, their findings, like ours, demonstrated heterogeneity in multimorbidity. The findings from aim 2 informed sampling for aim 3, the findings from which also highlighted themes regarding healthcare engagement based on burden of multimorbidity. Participant's experiences from these interviews indicated that those with closer alignment of their perceived and actual needs had greater engagement in care. The health constructs were also reflective of the degree of multimorbidity present in the class. The *Low Multimorbidity* class listed their health constructs and needs with respect to preventative health behaviors (i.e. quitting smoking, losing weight, etc.) while the *Multimorbidity with Psychiatric Comorbidity* class described specific provisions in their health construct and needs with respect to mental health care. Based on participant descriptions, the Health Belief Model may offer better constructs to understand these findings. Participants in the *Low Multimorbidity* class had lower level of perceived susceptibility and severity of health problems in contrast to those in the *Multimorbidity with Psychiatric Comorbidity* class. This later class also had high perceived susceptibility and severity of disease, particularly with respect to their mental health, while also influenced by perceived benefits of seeing their providers and taking actions for their health management (Becker, 1974; Champion & Skinner, 2008).

Health Behaviors

Aim 2 findings found that the *Multimorbidity* class was significantly less likely to report injection drug use exclusively compared to the *Multimorbidity with Psychiatric Comorbidity*

class. Other regressions signaled that the *Multimorbidity* class was less likely and the *Multimorbidity with Psychiatric Comorbidity* class was more likely to engage in substance use, but these findings were not significant. These findings taken with aim 3 findings indicate that health behaviors from chronic disease and substance use management varied across classes and were likely a function of the multimorbidity class.

Participants in their *Multimorbidity with Psychiatric Comorbidity* class in particular listed the care team and wrap around services as useful for their healthcare engagement, particularly for their mental health. Wrap-around services provide linkage to services including disability, housing, and social worker support. (Kay & Westfall, 2020). These services, however, are not often available at all clinic facilities and are often limited when available. The Comprehensive Addiction Resources Emergency (CARE) Act provides funding to health centers and systems for hiring clinicians and ancillary healthcare workers to provide these wrap-around services and improve engagement in care, particularly for the vulnerable subset of individuals with co-occurring mental health disorders (H.R.2569, 2019). Legislation of this nature expands much needed services that are often underfunded but were highlighted by study participants as necessary resources utilized for healthcare engagement.

The participants in the *Multimorbidity with Psychiatric Comorbidity* also listed the need to stabilize their mental health as a provision for cessation from substance use and injection. Multiple studies have shown that substance use and mental health disorders are highly correlated (Kelly & Daley, 2013; Klinkenberg & Sacks, 2004; Ross & Peselow, 2012). The *Multimorbidity with Psychiatric Comorbidity* was the only class with high odds of both outpatient and emergency room utilization from aim 2 analysis. While no study could be located to confirm our findings of a participant descriptions of stabilizing mental health as a means for substance use

cessation, some studies identified an unmet treatment need for individuals with triple diagnosis of substance use disorder, mental health disorder, and chronic disease. There is also some evidence demonstrating an improvement of chronic disease management following treatment for mental health disorder (Klinkenberg & Sacks, 2004; Tegger et al., 2008).

The *Multimorbidity with Psychiatric Comorbidity* class was significantly more likely than the *Low Multimorbidity* class to received medication for opioid use disorder. The use of MOUD varied across class, with participants in the *Multimorbidity* class listing non-medication strategies for recovery and even expressing some stigma against those who required medications. While not directly reported by participants, their language mirrored some language from 12-step programs, where there has been a persistent cultural stigma against those who utilize MOUD. Despite this, there is robust evidence of the benefits of MOUD, confirmed by participants in the *Low Multimorbidity* and *Multimorbidity with Psychiatric Comorbidity class* (Islam et al., 2013; Mehta et al., 2015; Miller et al., 2018; Morozova, Dvoriak, Pykalo, & Altice, 2017; Parmenter et al., 2013; Wang et al., 2013). Primary and integrated care facilities should provide MOUD for individuals with current or recovering substance use (DHHS, 2016). Additionally, there is evidence that peer based support groups, similar to 12 step programs, can play a role in long term recovery when they provide a holistic and non-stigmatized environment for participants (Krawczyk, Negron, Nieto, Agus, & Fingerhood, 2018). Finally, lack of providers with licenses to prescribe MOUD or limitations to the number of patients for whom they can prescribe has been shown to be a barrier to MOUD access for this population (Marino et al., 2019). Given participant's clear indication of MOUD as a provision for healthcare engagement, future legislation should remove barriers that healthcare providers face and allow for a seamless transition into integrated care.

Recommendations for Future Research

The Behavioral Model for Vulnerable Populations provides a guiding framework and conceptualization of factors in the aims of this study. However, there are two shortcomings of this model. The first is that it is adapted from a model with healthcare utilization as the main outcome. While later iterations of both the Andersen and BMVP models state their model captures other facets related to engagement in care with variables of satisfaction and preferences, it cannot justify being a healthcare engagement model without indicators of disease management. Second, the BMVP falls short in its conceptualization of the Need domain as it does not describe the relationship between perceived and actual needs and how this domain relates to healthcare outcomes. While no model exists to capture engagement in care, the Health Belief Model may offer better constructs to understand the Need gaps in the BMVP (Becker, 1974; Champion & Skinner, 2008). Figure 1 presents an update to the BMVP that incorporates elements of the Health Belief model that better conceptualize the Need based domain. Updates are the inclusion of perceived susceptibility and severity of disease, and perceived benefits and barriers as factors within the Needs domains (Becker, 1974; Champion & Skinner, 2008).

While no model exists to fully capture the full extent of engagement in care, especially with respect to disease management, there are methods available to better understand how individuals control and manage multimorbid diseases and substance use over time. First, given HIV and viral load suppression status were not associated with any of the multimorbidity classes, it is necessary to conduct similar analysis stratifying by HIV status to determine if multimorbidity and disease burden differ by HIV status. Additionally, using a similar approach to the latent class analysis presented here, latent trait analysis can utilize biological,

physiological, and psychometric indicators of disease and substance use control to highlight patterns in disease management. Utilizing this to better define actual need from the BMVP, then conduct qualitative interviews, ideally multiple interviews, with individuals from each profile of multimorbid disease control will enable enhanced triangulation of engagement in care for this population with better depth and precision.

Finally, further research should be completed targeting with the *Multimorbidity with Psychiatric Comorbidity* class. While this study was conducted with an overall vulnerable population, this class has increased vulnerability, as evidenced by the high burden of disease, utilization of emergency room services, and complex need and experiences with healthcare engagement described in qualitative interviews. While the BMVP with domains of the Health Belief model can provide global guidance on study conceptualization and framing, studies with this group should be pursued with an additional syndemic framework given the complicated but very evident relationship between mental health disorders and substance use. This group in particular during qualitative interviews indicated the need to stabilize their mental health prior to engaging in any other facet of their care. However, they also indicated the complicated nature of this process, and potential survival bias was also a potential issue in our findings. Future research will benefit from a broader age range in this class to understand the experiences with management of mental health and substance use over time and the interventions that can be applied earlier in life to prevent excess morbidity and mortality.

Conclusion

As current or former PWID seek healthcare, their needs extend beyond the traditional realms of substance use. This study demonstrates heterogeneity in multimorbidity for PWID with distinct latent classes. Two of these classes of multimorbidity indicate greater healthcare need as

well as interventions designed to improve engagement. Additionally, there is a large subsample of the population that has an enhanced need for care because of co-occurring mental health disorders. Clinicians can capitalize on the implications for each class, tailoring follow-up and care services to best address the needs of multimorbidity classes. Better understanding of participant's perceptions for optimal healthcare engagement can provide additional avenues for interventions and leverage strengths for sustained engagement.

Participants in this study highlighted multiple avenues for healthcare engagement, including positive patient-provider relationships, sustained health insurance, alignment of their healthcare needs with those designated by healthcare providers, and receipt of integrated care capable of address pressing health needs. Policy considerations include the continued provision of low barrier access to publicly available insurance, passage of legislation that provides funding for clinics to provide wrap-around services to individuals with substance use disorder, and removing MOUD prescription barriers. Finally, this study affirms the importance of healthcare meeting the needs of this population at the level they are able to accept care. Holistic healthcare systems can address these needs best with integrated care systems that provide for harm reduction, co-location with substance use and mental health treatment, and wrap around services, particularly as this population continues to age.

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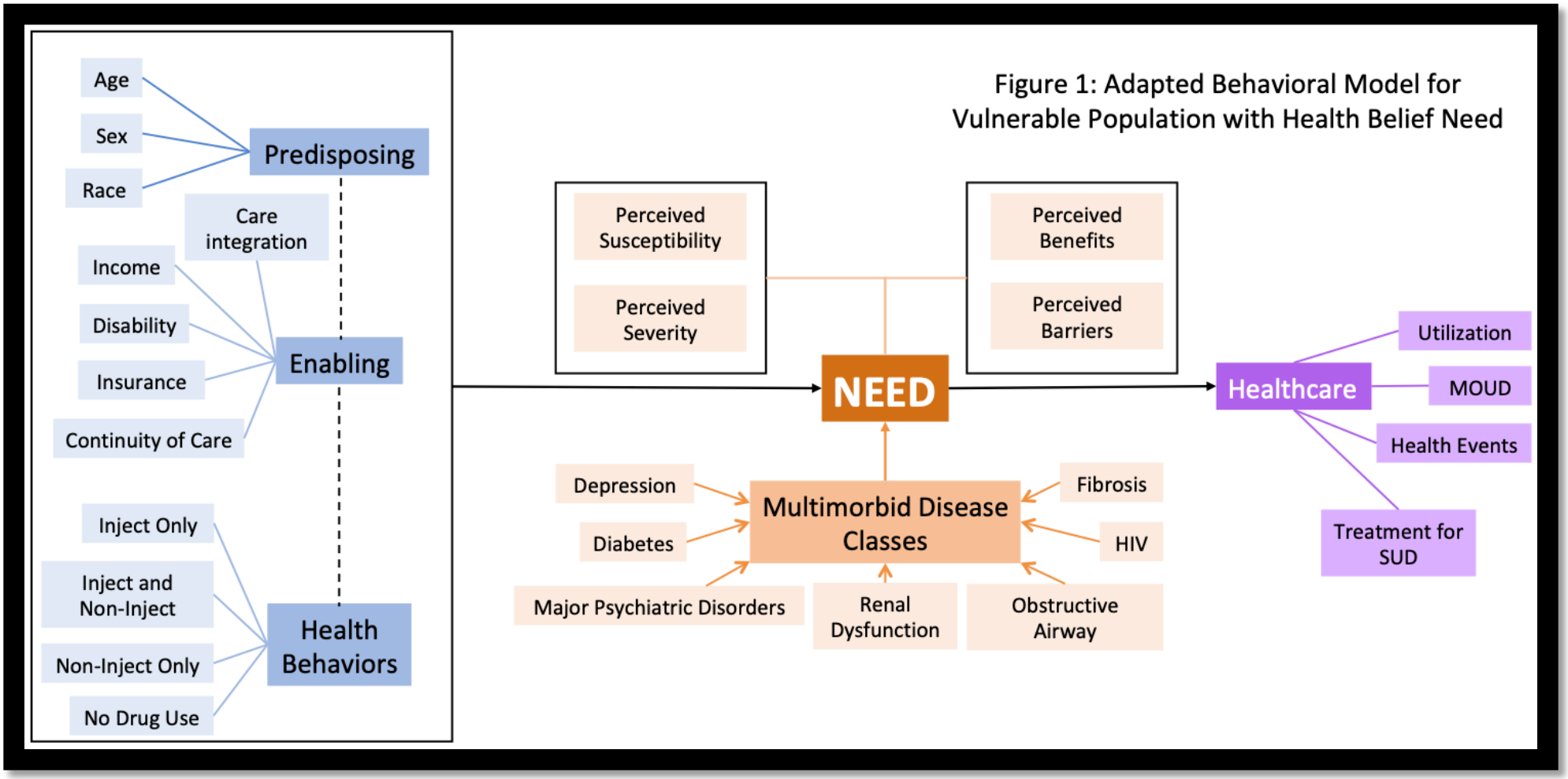
Figure 5.1 Adapted behavioral model for vulnerable populations with health belief model



APPENDIX

Field Guide for Qualitative Interviews

Thank you for agreeing to participate in this interview. Remember, you do not have to answer any questions that make you feel uncomfortable and you can discontinue this interview at any time.

Domain: Enabling Factors Overarching Question: What enabling factors act as facilitators or barriers to engagement in care?
• Tell me about what's happening in your life currently? *(Probe: Any changes in work/ any major life events?* • Tell me about the last time you went to see the doctor or a health care provider (*Probe: Where did you go? Why there? How did you get there?)* • Tell me about the place you normally go to seek health care, whatever that means to you (*Probe: Where did you go? Why there? How did you get there?)*

- What has your experience been with the staff there? (*Probe: The receptionist, medical assistants, nurses, pharmacists, etc.) (Probe: Can you tell me what they do that is helpful for your care? What do they do that is less helpful?*

- Can you tell me about financial barriers in receiving care? *(Probe: Do you have to pay when you get care? Is there copay? Did insurance cover the costs? How did you get connected to insurance?)*

Domain: Need Factors and Outcomes Overarching Question: How an individual conceptualize their health needs, meet those needs, and its relationship with satisfaction/engagement with care?
• What does being healthy mean to you? • What do you need to be healthy? • Tell me about your top health concerns *(Probe: What are some illnesses that you need to manage? / What are your needs when you seek out health care?)* • What are things you do to keep healthy given that you have XXX?

- What are things that prevent you from being healthy given that you have XXX?

- Does your health care meet your needs?

- What helps you feel satisfied with your care?

- What can be done to better meet your health care needs and satisfaction with care?

Domain: Health Behaviors Overarching Question: What are an individual's personal health practices and substance use and how to they relate to overall engagement in care?
• How does/did your care impact your substance use? *(Probe: Can you tell me whether your experience with the health care system has increased or decreased your drug use?)* • How have doctors, nurses, and other professionals helped you stay engaged in care?

Latent class analysis .do file

```
***Create a variable that lists the year of the visit
gen year=yofd(visdate)

***Create a variable that tags all ids with a visit in 2018
bysort id (year): egen tokeep = max(year==2018)

***Create a variable that tags all ids with a visit in 2014
bysort id (year): egen tokeep2= max(year==2014)

***Create a variable where 2 represents those who had a visit in 2014 & 18
gen tokeep3=tokeep+tokeep2

***Drop those with a tokeep2<2
drop if tokeep3<2

***Drop all observations before 2014
drop if year<2014


bys id (visdate): gen n=_n

rename samedoc2 samedocx

***Fibrosis in long form***
gen fibrosis=.
replace fibrosis=1 if fbscan<=7
replace fibrosis=2 if fbscan>7
replace fibrosis=3 if fbscan>=9.5
replace fibrosis=4 if fbscan>=12.5
replace fibrosis=. if fbscan==.

***covariates that are date dependent done in long form***
foreach v in m0f1 beduc age black cigyn alcyn auditcat mj crack snrtcoc injcoc spdbal smkher
snrther injher curuser ivstat abusescr prscrbmeth prscrbbup prscrbnalt samedoc samedocx er6m
outpat6m inpat6m inclt5k insur6m imcare6m imcaid6m ipriv6m share bmimedh disability od
odfreq hivvl50 {
        bysort id (visdate): egen `v'_cov=max(`v') if n==1
        bysort id (visdate): egen `v'_cov_fin=max(`v'_cov)
        }
```

```
***reshape wide***
keep id n black visdate hba1c chol bpsys bpdias hiv diabtx6m hcholtx6m hbptx6m hrtpbtx6m
renaltx6m lungdxtx6m copd maxfev fev_fvc hcvvis cesd23 gfr_naa gfr_aa hrt6m hrt6m_N
samedoc samedocx er6m outpat6m inpat6m outer6m evrskininfct blskininfct6m evrhrtdx
blhrtdx6m evrmyoinfrct blmyoinfrct6m evrhrtfail blhrtfail6m evrstroke blstroke6m evrarthritis
blarthritis6m evrcancer blcancer6m evrpneuma blpneum6m evrspsis blsepsis6m evrendo
blendo6m emeddep depdx6m deptx6m emedanx anxdx6m anxtx6m emedmand manddx6m
mandtx6m emedschi schidx6m schitx6m ehspmntl thoughts plan attempt skininfct6m hrtdx6m
myoinfrct6m hrtfail6m stroke6m arthritis6m pneum6m sepsis6m endo6m fbscan fibrosis
m0f1_cov_fin beduc_cov_fin age_cov_fin black_cov_fin cigyn_cov_fin alcyn_cov_fin
auditcat_cov_fin mj_cov_fin crack_cov_fin snrtcoc_cov_fin injcoc_cov_fin spdbal_cov_fin
smkher_cov_fin snrther_cov_fin injher_cov_fin curuser_cov_fin ivstat_cov_fin
abusescr_cov_fin prscrbmeth_cov_fin prscrbbup_cov_fin prscrbnalt_cov_fin samedoc_cov_fin
samedocx_cov_fin er6m_cov_fin outpat6m_cov_fin inpat6m_cov_fin inclt5k_cov_fin
insur6m_cov_fin imcare6m_cov_fin imcaid6m_cov_fin ipriv6m_cov_fin share_cov_fin
bmimedh_cov_fin od odfreq disability hivvl50 hivvl50_cov_fin

reshape wide black visdate hba1c chol bpsys bpdias hiv diabtx6m hcholtx6m hbptx6m
hrtpbtx6m renaltx6m lungdxtx6m copd maxfev fev_fvc hcvvis cesd23 gfr_naa gfr_aa hrt6m
hrt6m_N samedoc samedocx er6m outpat6m inpat6m outer6m evrskininfct blskininfct6m
evrhrtdx blhrtdx6m evrmyoinfrct blmyoinfrct6m evrhrtfail blhrtfail6m evrstroke blstroke6m
evrarthritis blarthritis6m evrcancer blcancer6m evrpneuma blpneum6m evrspsis blsepsis6m
evrendo blendo6m emeddep depdx6m deptx6m emedanx anxdx6m anxtx6m emedmand
manddx6m mandtx6m emedschi schidx6m schitx6m ehspmntl thoughts plan attempt skininfct6m
hrtdx6m myoinfrct6m hrtfail6m stroke6m arthritis6m pneum6m sepsis6m endo6m fbscan
fibrosis m0f1_cov_fin beduc_cov_fin age_cov_fin black_cov_fin cigyn_cov_fin alcyn_cov_fin
auditcat_cov_fin mj_cov_fin crack_cov_fin snrtcoc_cov_fin injcoc_cov_fin spdbal_cov_fin
smkher_cov_fin snrther_cov_fin injher_cov_fin curuser_cov_fin ivstat_cov_fin
abusescr_cov_fin prscrbmeth_cov_fin prscrbbup_cov_fin prscrbnalt_cov_fin samedoc_cov_fin
samedocx_cov_fin er6m_cov_fin outpat6m_cov_fin inpat6m_cov_fin inclt5k_cov_fin
insur6m_cov_fin imcare6m_cov_fin imcaid6m_cov_fin ipriv6m_cov_fin share_cov_fin
bmimedh_cov_fin od odfreq disability hivvl50 hivvl50_cov_fin, i(id) j(n)

***Diabetes****

foreach v in hba1c1 hba1c2 hba1c3 hba1c4 hba1c5 hba1c6 hba1c7 hba1c8 hba1c9 {
        gen diabetes`v'=`v'
        replace diabetes`v'=1 if `v'>=6.5
        replace diabetes`v'=0 if `v'<6.5
        replace diabetes`v'=0 if `v'==.
        }


***replace missing values with 0
```

```
foreach v in diabtx6m1 diabtx6m2 diabtx6m3 diabtx6m4 diabtx6m5 diabtx6m6 diabtx6m7
diabtx6m8 diabtx6m9 {
        replace `v'=0 if `v'==.
        }


gen diabetic= diabeteshba1c1+ diabeteshba1c2+ diabeteshba1c3+ diabeteshba1c4+
diabeteshba1c5+ diabeteshba1c6+ diabeteshba1c7+ diabeteshba1c8+ diabeteshba1c9 +
diabtx6m1+diabtx6m2+diabtx6m3+diabtx6m4+diabtx6m5+diabtx6m6+diabtx6m7+diabtx6m8+
diabtx6m9
tab diabetic

gen diabetic_final=diabetic
replace diabetic_final=1 if diabetic>=1
replace diabetic_final=0 if diabetic==0

tab diabetic_final


***Obstructive airway
foreach v in copd1 copd2 copd3 copd4 copd5 copd6 copd7 copd8 copd9 {
        gen copd`v'=`v'
        replace copd`v'=1 if `v'==1
        replace copd`v'=0 if `v'==0
        replace copd`v'=0 if `v'==.
        }


foreach v in lungdxtx6m1 lungdxtx6m2 lungdxtx6m3 lungdxtx6m4 lungdxtx6m5 lungdxtx6m6
lungdxtx6m7 lungdxtx6m8 lungdxtx6m9 {
        replace `v'=0 if `v'==.
        }



gen ob_air=
copdcopd1+copdcopd2+copdcopd3+copdcopd4+copdcopd5+copdcopd6+copdcopd7+copdcopd
8+copdcopd9+lungdxtx6m1+lungdxtx6m2+lungdxtx6m3+lungdxtx6m4+lungdxtx6m5+lungdxt
x6m6+lungdxtx6m7+lungdxtx6m8+lungdxtx6m9
tab ob_air

gen ob_air_final=ob_air
replace ob_air_final=1 if ob_air>=1
replace ob_air_final=0 if ob_air==0
```

```
egen ob_air2= rowtotal(copdcopd1 copdcopd2 copdcopd3 copdcopd4 copdcopd5 copdcopd6
copdcopd7 copdcopd8 copdcopd9)
gen ob_air2_final=ob_air2
replace ob_air2_final=1 if ob_air2>=1
replace ob_air2_final=0 if ob_air2==0

gen ob2_air=.
replace ob2_air=1 if copdcopd1==1 & copdcopd2==1
replace ob2_air=1 if copdcopd2==1 & copdcopd3==1
replace ob2_air=1 if copdcopd3==1 & copdcopd4==1
replace ob2_air=1 if copdcopd4==1 & copdcopd5==1
replace ob2_air=1 if copdcopd5==1 & copdcopd6==1
replace ob2_air=1 if copdcopd6==1 & copdcopd7==1
replace ob2_air=1 if copdcopd7==1 & copdcopd8==1
replace ob2_air=1 if copdcopd8==1 & copdcopd9==1
gen ob_air3_final=ob2_air
replace ob_air3_final=1 if ob2_air>=1
replace ob_air3_final=0 if ob2_air<1


***50% COPD!
***hiv
foreach v in hiv1 hiv2 hiv3 hiv4 hiv5 hiv6 hiv7 hiv8 hiv9 {
        gen hiv`v'=`v'
        replace hiv`v'=1 if `v'==1
        replace hiv`v'=0 if `v'==0
        replace hiv`v'=0 if `v'==.
        }


foreach v in hrt6m1 hrt6m2 hrt6m3 hrt6m4 hrt6m5 hrt6m6 hrt6m7 hrt6m8 hrt6m9 {
        replace `v'=0 if `v'==.
        }



gen hiv_tot=
hivhiv1+hivhiv2+hivhiv3+hivhiv4+hivhiv5+hivhiv6+hivhiv7+hivhiv8+hivhiv9+hrt6m1+hrt6m2
+hrt6m3+hrt6m4+hrt6m5+hrt6m6+hrt6m7+hrt6m8+hrt6m9
tab hiv_tot

gen hiv_final=hiv_tot
replace hiv_final=1 if hiv_tot>=1
replace hiv_final=0 if hiv_tot==0

***32% HIV
```

```
***HCV

foreach v in hcvvis1 hcvvis2 hcvvis3 hcvvis4 hcvvis5 hcvvis6 hcvvis7 hcvvis8 hcvvis9 {
        gen hcv`v'=`v'
        replace hcv`v'=1 if `v'==1
        replace hcv`v'=0 if `v'==0
        replace hcv`v'=0 if `v'==.
        }

gen hcv_tot=
hcvhcvvis1+hcvhcvvis2+hcvhcvvis3+hcvhcvvis4+hcvhcvvis5+hcvhcvvis6+hcvhcvvis7+hcvhcv
vis8+hcvhcvvis9
tab hcv_tot

gen hcv_final=hcv_tot
replace hcv_final=1 if hcv_tot>=1
replace hcv_final=0 if hcv_tot==0

***80% with HCV ab
***need to decide if we want to use this; compare it with HCV viral load, or use cirrhosis instead

****HTN****
gen sys=.
replace sys=1 if bpsys1>=140 & bpsys2>=140
replace sys=1 if bpsys2>=140 & bpsys3>=140
replace sys=1 if bpsys3>=140 & bpsys4>=140
replace sys=1 if bpsys4>=140 & bpsys5>=140
replace sys=1 if bpsys5>=140 & bpsys6>=140
replace sys=1 if bpsys6>=140 & bpsys7>=140
replace sys=1 if bpsys7>=140 & bpsys8>=140
replace sys=1 if bpsys8>=140 & bpsys9>=140

gen dias=.
replace dias=1 if bpdias1>=90 & bpdias2>=90
replace dias=1 if bpdias2>=90 & bpdias3>=90
replace dias=1 if bpdias3>=90 & bpdias4>=90
replace dias=1 if bpdias4>=90 & bpdias5>=90
replace dias=1 if bpdias5>=90 & bpdias6>=90
replace dias=1 if bpdias6>=90 & bpdias7>=90
replace dias=1 if bpdias7>=90 & bpdias8>=90
replace dias=1 if bpdias8>=90 & bpdias9>=90

egen htn_tx= rowtotal(hbptx6m1 hbptx6m2 hbptx6m3 hbptx6m4 hbptx6m5 hbptx6m6
hbptx6m7 hbptx6m8 hbptx6m9)
replace htn_tx=1 if htn_tx>=1
```

```
egen htn= rowtotal(sys dias htn_tx)
gen htn_final=htn
replace htn_final=1 if htn>=1
replace htn_final=0 if htn==0


****Depression****
***replace missing values with 0
foreach v in cesd231 cesd232 cesd233 cesd234 cesd235 cesd236 cesd237 cesd238 cesd239
depdx6m1 depdx6m2 depdx6m3 depdx6m4 depdx6m5 depdx6m6 depdx6m7 depdx6m8
depdx6m9 deptx6m1 deptx6m2 deptx6m3 deptx6m4 deptx6m5 deptx6m6 deptx6m7 deptx6m8
deptx6m9 emeddep1 emeddep2 emeddep3 emeddep4 emeddep5 emeddep6 emeddep7 emeddep8
emeddep9 {
        replace `v'=0 if `v'==.
        }


egen depression_dx= rowtotal(cesd231 cesd232 cesd233 cesd234 cesd235 cesd236 cesd237
cesd238 cesd239 depdx6m1 depdx6m2 depdx6m3 depdx6m4 depdx6m5 depdx6m6 depdx6m7
depdx6m8 depdx6m9 deptx6m1 deptx6m2 deptx6m3 deptx6m4 deptx6m5 deptx6m6 deptx6m7
deptx6m8 deptx6m9 emeddep1 emeddep2 emeddep3 emeddep4 emeddep5 emeddep6 emeddep7
emeddep8 emeddep9)
gen depression_final=depression
replace depression_final=1 if depression_dx>=1
replace depression_final=0 if depression_dx==0

tab depression_final

****Renal****
***every renaldx and renaldx6m are missing
foreach v in renaltx6m1 renaltx6m2 renaltx6m3 renaltx6m4 renaltx6m5 renaltx6m6 renaltx6m7
renaltx6m8 renaltx6m9 {
        replace `v'=0 if `v'==.
        }


gen gfr=.
replace gfr=1 if gfr_aa1<60 & black1==1
replace gfr=1 if gfr_aa2<60 & black1==1
replace gfr=1 if gfr_aa3<60 & black1==1
replace gfr=1 if gfr_aa4<60 & black1==1
replace gfr=1 if gfr_aa5<60 & black1==1
replace gfr=1 if gfr_aa6<60 & black1==1
replace gfr=1 if gfr_aa7<60 & black1==1
replace gfr=1 if gfr_aa8<60 & black1==1
replace gfr=1 if gfr_aa9<60 & black1==1
```

```
replace gfr=1 if gfr_naa1<60 & black1==0
replace gfr=1 if gfr_naa2<60 & black1==0
replace gfr=1 if gfr_naa3<60 & black1==0
replace gfr=1 if gfr_naa4<60 & black1==0
replace gfr=1 if gfr_naa5<60 & black1==0
replace gfr=1 if gfr_naa6<60 & black1==0
replace gfr=1 if gfr_naa7<60 & black1==0
replace gfr=1 if gfr_naa8<60 & black1==0
replace gfr=1 if gfr_naa9<60 & black1==0
replace gfr=0 if gfr==.

egen renal_dx=rowtotal(renaltx6m1 renaltx6m2 renaltx6m3 renaltx6m4 renaltx6m5 renaltx6m6
renaltx6m7 renaltx6m8 renaltx6m9 gfr)
gen renal_final=renal_dx
replace renal_final=1 if renal_dx>=1
replace renal_final=0 if renal_dx==0

****Anxiety****
foreach v in anxdx6m1 anxdx6m2 anxdx6m3 anxdx6m4 anxdx6m5 anxdx6m6 anxdx6m7
anxdx6m8 anxdx6m9 anxtx6m1 anxtx6m2 anxtx6m3 anxtx6m4 anxtx6m5 anxtx6m6 anxtx6m7
anxtx6m8 anxtx6m9 emedanx1 emedanx2 emedanx3 emedanx4 emedanx5 emedanx6 emedanx7
emedanx8 emedanx9 {
        replace `v'=0 if `v'==.
        }


egen anxiety_dx=rowtotal(anxdx6m1 anxdx6m2 anxdx6m3 anxdx6m4 anxdx6m5 anxdx6m6
anxdx6m7 anxdx6m8 anxdx6m9 anxtx6m1 anxtx6m2 anxtx6m3 anxtx6m4 anxtx6m5 anxtx6m6
anxtx6m7 anxtx6m8 anxtx6m9 emedanx1 emedanx2 emedanx3 emedanx4 emedanx5 emedanx6
emedanx7 emedanx8 emedanx9)
gen anxiety_final=anxiety_dx
replace anxiety_final=1 if anxiety_dx>=1
replace anxiety_final=0 if anxiety_dx==0

****Manic Depression****
foreach v in emedmand1 emedmand2 emedmand3 emedmand4 emedmand5 emedmand6
emedmand7 emedmand8 emedmand9 manddx6m1 manddx6m2 manddx6m3 manddx6m4
manddx6m5 manddx6m6 manddx6m7 manddx6m8 manddx6m9 mandtx6m1 mandtx6m2
mandtx6m3 mandtx6m4 mandtx6m5 mandtx6m6 mandtx6m7 mandtx6m8 mandtx6m9 {
        replace `v'=0 if `v'==.
        }


egen bipolar_dx=rowtotal(emedmand1 emedmand2 emedmand3 emedmand4 emedmand5
emedmand6 emedmand7 emedmand8 emedmand9 manddx6m1 manddx6m2 manddx6m3
manddx6m4 manddx6m5 manddx6m6 manddx6m7 manddx6m8 manddx6m9 mandtx6m1
```

```
mandtx6m2 mandtx6m3 mandtx6m4 mandtx6m5 mandtx6m6 mandtx6m7 mandtx6m8
mandtx6m9)
gen bipolar_final=bipolar_dx
replace bipolar_final=1 if bipolar_dx>=1
replace bipolar_final=0 if bipolar_dx==0

****Schizophrenia****
foreach v in emedschi1 emedschi2 emedschi3 emedschi4 emedschi5 emedschi6 emedschi7
emedschi8 emedschi9 schidx6m1 schidx6m2 schidx6m3 schidx6m4 schidx6m5 schidx6m6
schidx6m7 schidx6m8 schidx6m9 schitx6m1 schitx6m2 schitx6m3 schitx6m4 schitx6m5
schitx6m6 schitx6m7 schitx6m8 schitx6m9 {
        replace `v'=0 if `v'==.
        }


egen schizophrenia_dx=rowtotal(emedschi1 emedschi2 emedschi3 emedschi4 emedschi5
emedschi6 emedschi7 emedschi8 emedschi9 schidx6m1 schidx6m2 schidx6m3 schidx6m4
schidx6m5 schidx6m6 schidx6m7 schidx6m8 schidx6m9 schitx6m1 schitx6m2 schitx6m3
schitx6m4 schitx6m5 schitx6m6 schitx6m7 schitx6m8 schitx6m9)
gen schizophrenia_final=schizophrenia_dx
replace schizophrenia_final=1 if schizophrenia_dx>=1
replace schizophrenia_final=0 if schizophrenia_dx==0

****Athritis****
foreach v in  evrarthritis1 evrarthritis2 evrarthritis3 evrarthritis4 evrarthritis5 evrarthritis6
evrarthritis7 evrarthritis8 evrarthritis9 arthritis6m1 arthritis6m2 arthritis6m3 arthritis6m4
arthritis6m5 arthritis6m6 arthritis6m7 arthritis6m8 arthritis6m9 blarthritis6m1 blarthritis6m2
blarthritis6m3 blarthritis6m4 blarthritis6m5 blarthritis6m6 blarthritis6m7 blarthritis6m8
blarthritis6m9 {
        replace `v'=0 if `v'==.
        }


egen arthritis_dx=rowtotal(evrarthritis1 evrarthritis2 evrarthritis3 evrarthritis4 evrarthritis5
evrarthritis6 evrarthritis7 evrarthritis8 evrarthritis9 arthritis6m1 arthritis6m2 arthritis6m3
arthritis6m4 arthritis6m5 arthritis6m6 arthritis6m7 arthritis6m8 arthritis6m9 blarthritis6m1
blarthritis6m2 blarthritis6m3 blarthritis6m4 blarthritis6m5 blarthritis6m6 blarthritis6m7
blarthritis6m8 blarthritis6m9)
gen arthritis_final=arthritis_dx
replace arthritis_final=1 if arthritis_dx>=1
replace arthritis_final=0 if arthritis_dx==0

***collapsing Bipolar and Schizophrenia****
egen major_psych=rowtotal(bipolar_final schizophrenia_final)
generate major_psych_final=major_psych
replace major_psych_final=1 if major_psych==2
```

```
***stringent Depression****
gen depress=.
replace depress=1 if cesd231==1 & cesd232==1
replace depress=1 if cesd232==1 & cesd233==1
replace depress=1 if cesd233==1 & cesd234==1
replace depress=1 if cesd234==1 & cesd235==1
replace depress=1 if cesd235==1 & cesd236==1
replace depress=1 if cesd236==1 & cesd237==1
replace depress=1 if cesd237==1 & cesd238==1
replace depress=1 if cesd238==1 & cesd231==1

gen depress2=depress
replace depress2=0 if depress==.

****Composite Anxiety and Depression****
egen ad_stringent=rowtotal(depress anxiety_final)
gen ad_stringent_final=ad_stringent
replace ad_stringent_final=1 if ad_stringent>=1

egen ad_relax=rowtotal(depression_final anxiety_final)
gen ad_relax_final=ad_relax
replace ad_relax_final=1 if ad_relax>=1

***fibrosis***
egen fibrosis_final=rowmax(fibrosis1 fibrosis2 fibrosis3 fibrosis4 fibrosis5 fibrosis6 fibrosis7
fibrosis8 fibrosis9)
replace fibrosis_final=-9 if fibrosis_final==.

gen fibrosis_mplus=fibrosis_final
replace fibrosis_mplus=1 if fibrosis_final>=3
replace fibrosis_mplus=0 if fibrosis_final<3
replace fibrosis_mplus=-9 if fibrosis_final==-9

egen fibrosis2_final=rowmedian(fibrosis1 fibrosis2 fibrosis3 fibrosis4 fibrosis5 fibrosis6
fibrosis7 fibrosis8 fibrosis9)
replace fibrosis2_final=-9 if fibrosis_final==.

gen fibrosis2_mplus=fibrosis2_final
replace fibrosis2_mplus=1 if fibrosis_final>=3
replace fibrosis2_mplus=0 if fibrosis_final<3
replace fibrosis2_mplus=-9 if fibrosis_final==-9

***Covariates in wide form***
egen m0f1_mplus=rowmax(m0f1_cov_fin1 m0f1_cov_fin2 m0f1_cov_fin3 m0f1_cov_fin4
m0f1_cov_fin5 m0f1_cov_fin6 m0f1_cov_fin7 m0f1_cov_fin8 m0f1_cov_fin9)
```

```
egen beduc_mplus=rowmax(beduc_cov_fin1 beduc_cov_fin2 beduc_cov_fin3 beduc_cov_fin4
beduc_cov_fin5 beduc_cov_fin6 beduc_cov_fin7 beduc_cov_fin8 beduc_cov_fin9)

egen age2=rowmax(age_cov_fin1 age_cov_fin2 age_cov_fin3 age_cov_fin4 age_cov_fin5
age_cov_fin6 age_cov_fin7 age_cov_fin8 age_cov_fin9)

gen age_mplus=age2
replace age_mplus=0 if age2<55
replace age_mplus=1 if age2>=55

egen black_mplus=rowmax(black_cov_fin1 black_cov_fin2 black_cov_fin3 black_cov_fin4
black_cov_fin5 black_cov_fin6 black_cov_fin7 black_cov_fin8 black_cov_fin9)

egen cigyn_mplus=rowmax(cigyn_cov_fin1 cigyn_cov_fin2 cigyn_cov_fin3 cigyn_cov_fin4
cigyn_cov_fin5 cigyn_cov_fin6 cigyn_cov_fin7 cigyn_cov_fin8 cigyn_cov_fin9)

egen alcyn_mplus=rowmax(alcyn_cov_fin1 alcyn_cov_fin2 alcyn_cov_fin3 alcyn_cov_fin4
alcyn_cov_fin5 alcyn_cov_fin6 alcyn_cov_fin7 alcyn_cov_fin8 alcyn_cov_fin9)

egen auditcat_mplus=rowmax(auditcat_cov_fin1 auditcat_cov_fin2 auditcat_cov_fin3
auditcat_cov_fin4 auditcat_cov_fin5 auditcat_cov_fin6 auditcat_cov_fin7 auditcat_cov_fin8
auditcat_cov_fin9)

egen mj_mplus=rowmax(mj_cov_fin1 mj_cov_fin2 mj_cov_fin3 mj_cov_fin4 mj_cov_fin5
mj_cov_fin6 mj_cov_fin7 mj_cov_fin8 mj_cov_fin9)

egen crack_mplus=rowmax(crack_cov_fin1 crack_cov_fin2 crack_cov_fin3 crack_cov_fin4
crack_cov_fin5 crack_cov_fin6 crack_cov_fin7 crack_cov_fin8 crack_cov_fin9)

egen snrtcoc_mplus=rowmax(snrtcoc_cov_fin1 snrtcoc_cov_fin2 snrtcoc_cov_fin3
snrtcoc_cov_fin4 snrtcoc_cov_fin5 snrtcoc_cov_fin6 snrtcoc_cov_fin7 snrtcoc_cov_fin8
snrtcoc_cov_fin9)

egen injcoc_mplus=rowmax(injcoc_cov_fin1 injcoc_cov_fin2 injcoc_cov_fin3 injcoc_cov_fin4
injcoc_cov_fin5 injcoc_cov_fin6 injcoc_cov_fin7 injcoc_cov_fin8 injcoc_cov_fin9)

egen spdbal_mplus=rowmax(spdbal_cov_fin1 spdbal_cov_fin2 spdbal_cov_fin3
spdbal_cov_fin4 spdbal_cov_fin5 spdbal_cov_fin6 spdbal_cov_fin7 spdbal_cov_fin8
spdbal_cov_fin9)

egen smkher_mplus=rowmax(smkher_cov_fin1 smkher_cov_fin2 smkher_cov_fin3
smkher_cov_fin4 smkher_cov_fin5 smkher_cov_fin6 smkher_cov_fin8 smkher_cov_fin7
smkher_cov_fin9)
```

```
egen snrther_mplus=rowmax(snrther_cov_fin1 snrther_cov_fin2 snrther_cov_fin3
snrther_cov_fin4 snrther_cov_fin5 snrther_cov_fin6 snrther_cov_fin7 snrther_cov_fin8
snrther_cov_fin9)

egen injher_mplus=rowmax(injher_cov_fin1 injher_cov_fin2 injher_cov_fin3 injher_cov_fin4
injher_cov_fin5 injher_cov_fin6 injher_cov_fin7 injher_cov_fin8 injher_cov_fin9)

egen curuser_mplus=rowmax(curuser_cov_fin1 curuser_cov_fin2 curuser_cov_fin3
curuser_cov_fin4 curuser_cov_fin5 curuser_cov_fin6 curuser_cov_fin7 curuser_cov_fin8
curuser_cov_fin9)

egen ivstat_mplus=rowmax(ivstat_cov_fin1 ivstat_cov_fin2 ivstat_cov_fin3 ivstat_cov_fin4
ivstat_cov_fin5 ivstat_cov_fin6 ivstat_cov_fin7 ivstat_cov_fin8 ivstat_cov_fin9)

egen abusecr_mplus=rowmax(abusescr_cov_fin1 abusescr_cov_fin2 abusescr_cov_fin3
abusescr_cov_fin4 abusescr_cov_fin5 abusescr_cov_fin6 abusescr_cov_fin7 abusescr_cov_fin8
abusescr_cov_fin9)

egen prscrbmeth_mplus=rowmax(prscrbmeth_cov_fin1 prscrbmeth_cov_fin2
prscrbmeth_cov_fin3 prscrbmeth_cov_fin4 prscrbmeth_cov_fin5 prscrbmeth_cov_fin6
prscrbmeth_cov_fin7 prscrbmeth_cov_fin8 prscrbmeth_cov_fin9)

egen prscrbbup_mplus=rowmax(prscrbbup_cov_fin1 prscrbbup_cov_fin2 prscrbbup_cov_fin3
prscrbbup_cov_fin4 prscrbbup_cov_fin5 prscrbbup_cov_fin6 prscrbbup_cov_fin7
prscrbbup_cov_fin8 prscrbbup_cov_fin9)

egen prscrbnalt_mplus=rowmax(prscrbnalt_cov_fin1 prscrbnalt_cov_fin2 prscrbnalt_cov_fin3
prscrbnalt_cov_fin4 prscrbnalt_cov_fin5 prscrbnalt_cov_fin6 prscrbnalt_cov_fin7
prscrbnalt_cov_fin8 prscrbnalt_cov_fin9)

egen ost=rowmax(prscrbmeth_cov_fin1 prscrbmeth_cov_fin2 prscrbmeth_cov_fin3
prscrbmeth_cov_fin4 prscrbmeth_cov_fin5 prscrbmeth_cov_fin6 prscrbmeth_cov_fin7
prscrbmeth_cov_fin8 prscrbmeth_cov_fin9 prscrbbup_cov_fin1 prscrbbup_cov_fin2
prscrbbup_cov_fin3 prscrbbup_cov_fin4 prscrbbup_cov_fin5 prscrbbup_cov_fin6
prscrbbup_cov_fin7 prscrbbup_cov_fin8 prscrbbup_cov_fin9 prscrbnalt_cov_fin1
prscrbnalt_cov_fin2 prscrbnalt_cov_fin3 prscrbnalt_cov_fin4 prscrbnalt_cov_fin5
prscrbnalt_cov_fin6 prscrbnalt_cov_fin7 prscrbnalt_cov_fin8 prscrbnalt_cov_fin9)
generate ost_mplus=ost
replace ost_mplus=1 if ost>=1
replace ost_mplus=0 if ost==0

egen samedoc_mplus=rowmax(prscrbnalt_cov_fin1 prscrbnalt_cov_fin2 prscrbnalt_cov_fin3
prscrbnalt_cov_fin4 prscrbnalt_cov_fin5 prscrbnalt_cov_fin6 prscrbnalt_cov_fin7
prscrbnalt_cov_fin8 prscrbnalt_cov_fin9)
```

```
egen samedocx_mplus=rowmax(samedocx_cov_fin1 samedocx_cov_fin2 samedocx_cov_fin3
samedocx_cov_fin4 samedocx_cov_fin5 samedocx_cov_fin6 samedocx_cov_fin7
samedocx_cov_fin8 samedocx_cov_fin9)

egen er6m_mplus=rowmax(er6m_cov_fin1 er6m_cov_fin2 er6m_cov_fin3 er6m_cov_fin4
er6m_cov_fin5 er6m_cov_fin6 er6m_cov_fin7 er6m_cov_fin8 er6m_cov_fin9)

egen outpat_mplus=rowmax(outpat6m_cov_fin1 outpat6m_cov_fin2 outpat6m_cov_fin3
outpat6m_cov_fin4 outpat6m_cov_fin5 outpat6m_cov_fin6 outpat6m_cov_fin7
outpat6m_cov_fin8 outpat6m_cov_fin9)

egen inpat_mplus=rowmax(inpat6m_cov_fin1 inpat6m_cov_fin2 inpat6m_cov_fin3
inpat6m_cov_fin4 inpat6m_cov_fin5 inpat6m_cov_fin6 inpat6m_cov_fin7 inpat6m_cov_fin8
inpat6m_cov_fin9)

egen inclt5k_mplus=rowmax(inclt5k_cov_fin1 inclt5k_cov_fin2 inclt5k_cov_fin3
inclt5k_cov_fin4 inclt5k_cov_fin5 inclt5k_cov_fin6 inclt5k_cov_fin7 inclt5k_cov_fin8
inclt5k_cov_fin9)

egen insur6m_mplus=rowmax(insur6m_cov_fin1 insur6m_cov_fin2 insur6m_cov_fin3
insur6m_cov_fin4 insur6m_cov_fin5 insur6m_cov_fin6 insur6m_cov_fin7 insur6m_cov_fin8
insur6m_cov_fin9)

egen imcare6m_mplus=rowmax(imcare6m_cov_fin1 imcare6m_cov_fin2 imcare6m_cov_fin3
imcare6m_cov_fin4 imcare6m_cov_fin5 imcare6m_cov_fin6 imcare6m_cov_fin7
imcare6m_cov_fin8 imcare6m_cov_fin9)

egen imcaid6m_mplus=rowmax(imcaid6m_cov_fin1 imcaid6m_cov_fin2 imcaid6m_cov_fin3
imcaid6m_cov_fin4 imcaid6m_cov_fin5 imcaid6m_cov_fin6 imcaid6m_cov_fin7
imcaid6m_cov_fin8 imcaid6m_cov_fin9)

egen ipriv6m_mplus=rowmax(ipriv6m_cov_fin1 ipriv6m_cov_fin2 ipriv6m_cov_fin3
ipriv6m_cov_fin4 ipriv6m_cov_fin5 ipriv6m_cov_fin6 ipriv6m_cov_fin7 ipriv6m_cov_fin8
ipriv6m_cov_fin9)

egen bmimedh_mplus=rowmax(bmimedh_cov_fin1 bmimedh_cov_fin2 bmimedh_cov_fin3
bmimedh_cov_fin4 bmimedh_cov_fin5 bmimedh_cov_fin6 bmimedh_cov_fin7
bmimedh_cov_fin8 bmimedh_cov_fin9)

egen skin_final=rowtotal(evrskininfct1 evrskininfct2 evrskininfct3 evrskininfct4 evrskininfct5
evrskininfct6 evrskininfct7 evrskininfct8 evrskininfct9 blskininfct6m1 blskininfct6m2
blskininfct6m3 blskininfct6m4 blskininfct6m5 blskininfct6m6 blskininfct6m7 blskininfct6m8
blskininfct6m9 skininfct6m1 skininfct6m2 skininfct6m3 skininfct6m4 skininfct6m5
skininfct6m6 skininfct6m7 skininfct6m8 skininfct6m9)
generate skin_mplus=skin_final
replace skin_mplus=1 if skin_final>=1
```

```
replace skin_mplus=0 if skin_final==0

egen hrtdx_final=rowtotal(evrhrtdx1 evrhrtdx2 evrhrtdx3 evrhrtdx4 evrhrtdx5 evrhrtdx6
evrhrtdx7 evrhrtdx8 evrhrtdx9 blhrtdx6m1 blhrtdx6m2 blhrtdx6m3 blhrtdx6m4 blhrtdx6m5
blhrtdx6m6 blhrtdx6m7 blhrtdx6m8 blhrtdx6m9 hrtdx6m1 hrtdx6m2 hrtdx6m3 hrtdx6m4
hrtdx6m5 hrtdx6m6 hrtdx6m7 hrtdx6m8 hrtdx6m9)
generate hrtdx_mplus=hrtdx_final
replace hrtdx_mplus=1 if hrtdx_final>=1
replace hrtdx_mplus=0 if hrtdx_final==0

egen MI_final=rowtotal(evrmyoinfrct1 evrmyoinfrct2 evrmyoinfrct3 evrmyoinfrct4
evrmyoinfrct5 evrmyoinfrct6 evrmyoinfrct7 evrmyoinfrct8 evrmyoinfrct9 blmyoinfrct6m1
blmyoinfrct6m2 blmyoinfrct6m3 blmyoinfrct6m4 blmyoinfrct6m5 blmyoinfrct6m6
blmyoinfrct6m7 blmyoinfrct6m8 blmyoinfrct6m9 myoinfrct6m1 myoinfrct6m2 myoinfrct6m3
myoinfrct6m4 myoinfrct6m5 myoinfrct6m6 myoinfrct6m7 myoinfrct6m8 myoinfrct6m9)
generate MI_mplus=MI_final
replace MI_mplus=1 if MI_final>=1
replace MI_mplus=0 if MI_final==0

egen hrtfail_final=rowtotal(evrhrtfail1 evrhrtfail2 evrhrtfail3 evrhrtfail4 evrhrtfail5 evrhrtfail6
evrhrtfail7 evrhrtfail8 evrhrtfail9 blhrtfail6m1 blhrtfail6m2 blhrtfail6m3 blhrtfail6m4
blhrtfail6m5 blhrtfail6m6 blhrtfail6m7 blhrtfail6m8 blhrtfail6m9 hrtfail6m1 hrtfail6m2
hrtfail6m3 hrtfail6m4 hrtfail6m5 hrtfail6m6 hrtfail6m7 hrtfail6m8 hrtfail6m9)
generate hrtfail_mplus=hrtfail_final
replace hrtfail_mplus=1 if hrtfail_final>=1
replace hrtfail_mplus=0 if hrtfail_final==0

egen stroke_final=rowtotal(evrstroke1 evrstroke2 evrstroke3 evrstroke4 evrstroke5 evrstroke6
evrstroke7 evrstroke8 evrstroke9 blstroke6m1 blstroke6m2 blstroke6m3 blstroke6m4
blstroke6m5 blstroke6m6 blstroke6m7 blstroke6m8 blstroke6m9 stroke6m1 stroke6m2
stroke6m3 stroke6m4 stroke6m5 stroke6m6 stroke6m7 stroke6m8 stroke6m9)
generate stroke_mplus=stroke_final
replace stroke_mplus=1 if stroke_final>=1
replace stroke_mplus=0 if stroke_final==0

egen cancer_final=rowtotal(evrcancer1 evrcancer2 evrcancer3 evrcancer4 evrcancer5 evrcancer6
evrcancer7 evrcancer8 evrcancer9 blcancer6m1 blcancer6m2 blcancer6m3 blcancer6m4
blcancer6m5 blcancer6m6 blcancer6m7 blcancer6m8 blcancer6m9)
generate cancer_mplus=cancer_final
replace cancer_mplus=1 if cancer_final>=1
replace cancer_mplus=0 if cancer_final==0

egen pneuma_final=rowtotal(evrpneuma1 evrpneuma2 evrpneuma3 evrpneuma4 evrpneuma5
evrpneuma6 evrpneuma7 evrpneuma8 evrpneuma9 blpneum6m1 blpneum6m2 blpneum6m3
blpneum6m4 blpneum6m5 blpneum6m6 blpneum6m7 blpneum6m8 blpneum6m9 pneum6m1
pneum6m2 pneum6m3 pneum6m4 pneum6m5 pneum6m6 pneum6m7 pneum6m8 pneum6m9)
```

```
generate pneuma_mplus=pneuma_final
replace pneuma_mplus=1 if pneuma_final>=1
replace pneuma_mplus=0 if pneuma_final==0

egen sepsis_final=rowtotal(evrspsis1 evrspsis2 evrspsis3 evrspsis4 evrspsis5 evrspsis6 evrspsis7
evrspsis8 evrspsis9 blsepsis6m1 blsepsis6m2 blsepsis6m3 blsepsis6m4 blsepsis6m5 blsepsis6m6
blsepsis6m7 blsepsis6m8 blsepsis6m9 sepsis6m1 sepsis6m2 sepsis6m3 sepsis6m4 sepsis6m5
sepsis6m6 sepsis6m7 sepsis6m8 sepsis6m9)
generate sepsis_mplus=sepsis_final
replace sepsis_mplus=1 if sepsis_final>=1
replace sepsis_mplus=0 if sepsis_final==0

egen endo_final=rowtotal(evrendo1 evrendo2 evrendo3 evrendo4 evrendo5 evrendo6 evrendo7
evrendo8 evrendo9 blendo6m1 blendo6m2 blendo6m3 blendo6m4 blendo6m5 blendo6m6
blendo6m7 blendo6m8 blendo6m9 endo6m1 endo6m2 endo6m3 endo6m4 endo6m5 endo6m6
endo6m7 endo6m8 endo6m9)
generate endo_mplus=endo_final
replace endo_mplus=1 if endo_final>=1
replace endo_mplus=0 if endo_final==0

egen attempt_final=rowtotal(attempt1 attempt2 attempt3 attempt4 attempt5 attempt6 attempt7
attempt8 attempt9)
generate attempt_mplus=attempt_final
replace attempt_mplus=1 if attempt_final>=1
replace attempt_mplus=0 if attempt_final==0

egen disability_mplus=rowmax(disability1 disability2 disability3 disability4 disability5
disability6 disability7 disability8 disability9)

egen heroin_mplus=rowmax(smkher_mplus snrther_mplus injher_mplus)
egen cocaine_mplus=rowmax(injcoc_mplus snrtcoc_mplus)
egen anydrug6m_mplus=rowmax(heroin_mplus cocaine_mplus spdbal_mplus crack_mplus)
replace anydrug6m_mplus=1 if anydrug6m_mplus>=1
replace anydrug6m_mplus=0 if anydrug6m_mplus==0
replace anydrug6m_mplus=1 if curuser_mplus==1

egen newdrugvar=rowtotal(anydrug6m_mplus curuser_mplus)
replace newdrugvar=2 if curuser_mplus==1

gen drug_none=.
replace drug_none=1 if newdrugvar==0
replace drug_none=0 if drug_none==.

gen drug_noninj=.
replace drug_noninj=1 if newdrugvar==1
replace drug_noninj=0 if drug_noninj==.
```

```
gen drug_inj=.
replace drug_inj=1 if newdrugvar==2
replace drug_inj=0 if drug_inj==.

gen noni_inj=(drug_inj+drug_noninj)

egen event_id=rowmax(pneuma_mplus endo_mplus sepsis_mplus skin_mplus)
egen event_cvd=rowmax(stroke_mplus hrtfail_mplus MI_mplus hrtdx_mplus)


foreach var of varlist _all {
        replace `var'=-9 if `var'==.
        }

***MPlus file***
keep id diabetic_final htn_final ob_air2_final renal_final  arthritis_final ad_stringent_final
major_psych_final fibrosis_mplus ipriv6m_mplus imcaid6m_mplus imcare6m_mplus
insur6m_mplus inclt5k_mplus outpat_mplus er6m_mplus samedocx_mplus ost_mplus
abusecr_mplus curuser_mplus injher_mplus snrther_mplus smkher_mplus spdbal_mplus
injcoc_mplus snrtcoc_mplus crack_mplus mj_mplus alcyn_mplus cigyn_mplus black_mplus
m0f1_mplus age_mplus disability_mplus anydrug6m_mplus event_id event_cvd depress2
newdrugvar drug_none drug_noninj drug_in
```

Codebook for Qualitative Data

1.0 Current Life	Current life events in response to question 1
2.0 Enabling Factors	Enabling factors that act as facilitators and barriers to engagement in care
2.1 EF_Current HC Reason and Location	Reason why and where they went for healthcare including transportation
2.2 EF_Current HC Staff	Experience with non-medical staff where they seek care
2.3 EF_Current HC Providers	Experience with medical staff where they seek care
2.4 EF_Care team facilitators	Discussion about how Medical and Non-medical staff help their care
2.5 EF_Care team barriers	Discussion about how Medical and Non-medical staff impede their care
2.6 EF_Financial facilitators	Discussion about how insurance, copay, or other monetary costs help their care
2.7 EF_Financial barriers	Discussion about how insurance, copay, or other monetary costs impede their care
2.8 EF_Social facilitators	Discussion about how social network helps their care
2.9 EF_Social barriers	Discussion about how social network imedes their care
3.0 Need Factors	Factors that relate to health care needs, including preceived and actual need
3.1 NF_ Being Healthy	Descriptions of what being healthy means to the participant
3.2 NF_ Healthy Needs	Details about what the participant needs to achieve their healthy construct
3.3 NF_ Health concerns	Description of major health concerns
3.4 NF_ Chronic Dx Health	Description of health needs concerning a specific of multiple diseases (code with a disease)
3.5 NF_ Chronic Dx barriers	Barriers that prevent participant from managing specific chronic diseases (code with a disease)
3.6 NF_ HC Satisfaction	Description of satisfaction with health care
3.7 NF_ HC Satifaction Needs	Health care addressing their needs
3.8 NF_ HC Satisfaction Improve	Descriptions of how to better meet health needs and improve satisfaction
4.0 Substance Use Health Behaviors	Health Behaviors/Practices related to substance use and their relationship to engagment in care
4.1 SU_ Health professionals engage	Impact of health professions on staying engaged in care for substance use recovery/management, including SU reduction
4.2 SU_Harm reduction	Engagement in harm reduction including using clean needles, testing their drug supply, knowing their dealer, using condoms, etc.
4.3 SU_Motivations	Non medical or personal motivating factors related to substance use management

4.4 SU_Deterrents	Non medical or personal factors that discourage or hinder substance use management
4.5 SU_Future behaviors	References to behaviors participants will undertake to reduce substance use
4.6 SU_ Future services	References to services participants will access to reduce substance use
4.7 SU_Advice	Advice or feedback on what health professionals and patients could do to engage participants in Substance Use recovery
5.0 Chronic Disease Health Behaviors	Health Behaviors/Practices related to chronic disease management and their relationship to engagment in care
5.1 CD_Health professionals engage	Impact of health professionals on staying engaged in care for chronic disease management
5.2 CD_Motivations	Non medical or personal motivating factors related to chronic disease management
5.3 CD_Deterrents	Non medical or personal factors that discourage or hinder chronic disease management
5.4 CD_Future behaviors	References to behaviors participants will undertake to achieve their optimal health for chronic diseases
5.5 CD_ Future services	References to services participants will seek for chronic disease management
5.6 CD_Advice	Advice or feedback on what health professionals and patients could do to engage participants in chronic disease care
6.0 Safe Consumption Space	Discussion about thoughts on the implentation of a safe consumption space.
6.1 SCS_Barriers	Discussion about potential barriers and drawback to creating a Safe Consumption Space
6.2 SCS_Facilitator	Discussion about potential facilitators and benefits to creating a Safe Consumption Space
HIV	
Hepatitis C	
Diabetes	
Hypertension	
Pain Management	
Mental Health	
Medications	
Medication for Opioid Use Disorder	

CURRICULUM VITAE

PERSONAL DATA

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Education

Year	Degree Earned	Institution/Location
2020	Doctor of Philosophy, candidate	Johns Hopkins University School of Nursing, Baltimore, MD
2017	Master of Public Health	Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD
2017	Master of Science	Johns Hopkins University School of Nursing, Baltimore, MD
2013	Bachelor or Science	The University of California, Irvine, School of Nursing Irvine, CA

Fellowships

2017-2020 Robert Wood Johnson Foundation, Future of Nursing Scholars Program

CURRENT LICENSE AND CERTIFICATION

Year	Source	License Number/ Certification	Type	Expiration
2019	United States Drug Enforcement Agency (DEA)	On Request	DEA	2022
2019	Maryland Controlled Substance Registration	On Request	CDS	2022
2017	Maryland Board of Nursing	R218569-NP	CRNP	2021
2015	Maryland Board of Nursing	R218569	RN	2021
2013	California Board of Nursing	846803	RN	2020

PROFESSIONAL EXPERIENCE

Years	Position	Institution/Location
2019- Present	Adult Nurse Practitioner	Family Health Centers of Baltimore

		Baltimore, MD
2018- Present	Adult Nurse Practitioner	Johns Hopkins University, School of Medicine, John G. Bartlett Specialty Practice, Johns Hopkins AIDS Service
2019- Present	Getting to Zero Educator	Johns Hopkins University, School of Nursing, REACH Initiative, Baltimore, MD
2013-2015	Critical Care Registered Nurse	CHOC Children's Hospital, Orange, CA

HONORS AND AWARDS

2019	UC Irvine Distinguished Alumnus Award
2019	Lancet Poster Competition Winner
2018	Johns Hopkins Nursing Advisory Board 130th Anniversary Award
2018	Scholl Foundation Dissertation Funding Award
2017	Johns Hopkins University School of Nursing Deans Scholarship
2016	Cele and Pete Borcuk Scholarship
2015	Advanced Education Nursing Traineeship (AENT) Scholarship
2014	Children's Hospital Orange County Evidence Based Scholar
2013	University of California, Irvine Nursing Leadership Award
2012	Undergraduate Research Opportunity Program Researcher of the Month

RESEARCH

2016- Present AIDS Linked Intravenous Experience (ALIVE)

November 2016-present
Masters Project: Secondary analysis of fibroscan data to assess the effect of neighborhood factors on disease progression

Dissertation: Healthcare for people who inject drugs: Assessing engagement and unmet need

2017- Present A Nurse Case Management Intervention to Improve MDR-TB/HIV Co-infection Outcomes
Secondary analysis of an ongoing cluster randomized control trial to examine tuberculosis and HIV continuum of care outcomes.

2017- Present Pre-Exposure Prophylaxis (PrEP) Care Anywhere

November 2017-present
Study clinician conducting baseline and follow-up in person and telemedicine visits
Designed data collection procedures and materials

2017 Matla Mobile: Mobile Health project

March 2017-August 2017
Design and implementation of a pilot study assessing a mHealth intervention with HIV and Tuberculosis patients

2016- 2017 Centers for Disease Control –Category C Demonstration Project

January 2016-August 2017
Evaluation of the Baltimore City Health Department's HIV high viral load protocol

Evaluator for Project PrIDE to implement to reduce new HIV infections in MSM and transgender persons.

SCHOLARSHIP

Peer Reviewed Publications

1. Marg, L., **Heidari., O**., Taylor., J., et al. (2019). A multidimensional assessment of successful aging among older people living with HIV in Palm Springs, California. *AIDS Research and Human Retroviruses. 35* (11-12): 1174-1180

2. Rhoades NS., Mendoza N., Jankeel A., Sureschandra, S., Alvarez, AD., Doratt, B., **Heidari, O**., et. al. (2019). Altered immunity and microbial dysbiosis in aged individuals with long-term controlled HIV infection. *Frontiers in Immunology.*

3. Schumacher CM, Fields E, Chandran A, **Heidari O**, Kingon Y, Chaulk P, Jennings JM. Investigation of Early Syphilis Trends among Men Who Have Sex with Men to Identify Gaps in Screening and Case-Finding in Baltimore City, Maryland. *Sex Transm Dis 45* (2): 69-74.

4. **Heidari, O**., Ghuman, P., Soohoo, M., et al. (2014). Using financial incentives for HIV prevention studies in diverse global contexts: A literature review. *Nigerian Journal of Health Sciences,14*, 39-51.

5. Brown, B., Blas, M., **Heidari, O**., et al. (2013). Reported changes in sexual behavior and human papillomavirus knowledge in Peruvian female sex workers following participation in human papillomavirus vaccine trial. *International Journal of STI and AIDS, 24*(7), 531-535.

Under Review

- **Heidari, O.,** Dangerfield, D., & Hickson, D. (2019). Sexual risk and healthcare utilization profiles among Black sexual minority men in the Deep South. Manuscript submitted to: *AIDS Care.*

- Dangerfield, D., **Heidari, O**., Cooper, J., Allen, S., & Lucas, G. (2019). Opioid and Stimulant Use Among Black Sexual Minority Men: A Life Course Perspective. Manuscript submitted to: *Drug and Alcohol Dependence.*

- Dangerfield, D., Cooper, J., **Heidari, O**., Allen, S., & Lucas, G. (2019). Nursing and healthcare preferences among opioid and stimulant Black men who have sex with men. Manuscript submitted to: *Journal of Clinical Nursing.*

- DiAndreth, L., Jarrett, B., Martinson, N., …., **Heidari, O**., Golub, J. (2019). Secure delivery of HIV-related and tuberculosis laboratory results to patient cell phones: A pilot comparative study. Manuscript submitted to: *Aids and Behavior.*

- Farley, J., Dangerfield, D., LaRicci, J., Sacamano, P., **Heidari, O.**, Lowensen, K., Jennings., Tobin, K. Community awareness, engagement and linkage to care efforts by peer community-health workers to increase PrEP uptake among men who have sex with men in Baltimore, Maryland. Manuscript submitted to*: BMC Public Health*

Poster Sessions

2019 American Public Health Association
A multidimensional assessment of successful aging among older people living with HIV in the Coachella Valley.

2019 Consortium of Universities in Global Health (CUGH)
Evaluating HIV 90-90-90 Targets for Individuals Undergoing Drug-Resistant Tuberculosis Treatment

- Lancet poster competition winner

2017 Johns Hopkins University, Global Health Day
Piloting a mHealth Intervention to Increase Retention in HIV and Tuberculosis Care

2015 University of California Global health Conference, UCLA, California
Ethical Imperative of Improving Access and Availability of the HPV Vaccine Among High Risk Populations

2012 University of California Global Health Conference, UC Berkeley, California | 2012 International Papillomavirus Conference, San Juan, Puerto Rico
Change in sexual behavior and HPV knowledge in Peruvian female sex workers following participation in an HPV vaccine clinical trial

PROFESSIONAL ACTIVITIES/MEMBERSHIPS

2019- Present	**WYPR 88.1 Community Advisory Board Member**
2015- Present	**Sigma Theta Tau International**
2015- Present	**American Association for Nurses in AIDS Care**
2018-2019	**Johns Hopkins University Doctor of Philosophy Board**
2016-2018	**Johns Hopkins School of Nursing Diversity and Inclusion Committee**
2015-2017	**Students for a Positive Academic Partnership with the Baltimore Community (SPARC) |** Executive Board Member

TEACHING ACTIVITIES

Classroom Instruction Johns Hopkins University, School of Nursing

2019 Winterim	NR.110.612, Diagnosis, Care and Management of Persons with HIV/AIDS, Lead Teaching Assistant and Course Lecturer
2018 Fall	NR.110.614 Primary Care for Patients in Limited Resource Settings, Lead Teaching Assistant and Course Lecturer
2018 Winterim	NR.110.612, Diagnosis, Care and Management of Persons with HIV/AIDS, Lead Teaching Assistant and Course Lecturer